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A RECORD OF

CONTRIBUTIONS

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PRETORIA

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Notes on some Species of Cladophora from South Africa.

By

R. H. Simons.

Several species of *Cladophora* have been collected during an investigation of Cape seaweeds and most have been readily identified by comparison with named specimens in the Stephenson and Tyson collections of South African seaweeds at the University of Cape Town. Most of Stephenson's material was identified by himself, but it includes some specimens named by overseas authorities. The type specimens of certain species that have particularly interested me are in the Agardh Herbarium in Lund and are not available on loan, which has meant falling back largely on literature for checking identifications. In general, the determination of Cladophoras by these methods has given little dificulty. But there is confusion in the application of the names *C. flagelliformis*, *C. capensis* and *C. virgata*, and the present paper attempts to resolve the difficulty.

The Tyson specimens under these three names were determined by G. F. Papenfuss in 1939, whereas the Stephenson material was apparently named when collected about 1937. It was obvious that most of Stephenson's specimens of *C. flagelliformis* and *C. virgata* did not correspond respectively in morphology with specimens so named by Papenfuss in the Tyson collection. The following paragraph was found in a paper by Stephenson (1944) and accounts for this discrepancy: " There are two common species of *Cladophora*, quite distinct in appearance, which bear these names [*C. flagelliformis* and *C. virgata*]. One of them is a long, coarse, blue-green species, the other a shorter, silkier, bright green form. The former has hitherto been known as *flagelliformis*, the latter as *virgata*. It now proves that the two names should be interchanged, so that the coarse plant becomes *virgata*, the other *flagelliformis* ". Once the suggested interchange of names had been made in Stephenson's material the discrepancy between this and Papenfuss's (Tyson collection) was removed.

This should have resolved any further difficulty in identifying specimens of these two species, but instead I found that according to the original literature *C. flagelliformis* and *C. virgata* are closely similar, whereas in the material at hand there was a likeness between plants named *C. flagelliformis* and some of those named *C. capensis*, but a dissimilarity between those named *C. flagelliformis* and *C. virgata*.

On comparing the literature on *C. flagelliformis*, it was found that the plants so named in the Stephenson and Tyson collections disagreed in several respects with the original description but agreed with the description given by Levring (1938), thus suggesting that Levring, Papenfuss and Stephenson (after his correction) had misapplied the name.

Stephenson stated that *C. flagelliformis* and *C. virgata* are " quite distinct in their appearance ". This is contrary to the views of Kützing (1843), who transferred these species to *Cladophora*, and of de Toni (1889, p. 331). Kützing related the two species closely but stated that *C. flagelliformis* is longer and more slender than *C. virgata* and de Toni added that they are " scarcely distinct ". Areschoug (1851) goes further and says they are synonymous. Moreover, Kützing and Stephenson disagree as to which is the longer species, for Stephenson stated that this is *C. virgata*.

If a general comparison of Kützing's description of *C. flagelliformis* is made with Stephenson's material under the name *C. virgata* a conformity is immediately apparent. Both have shorter and more slender branches in the lower parts and longer flagelliform branches above. The dilation of all branches towards their apices is characteristic of both, and cell proportions in comparable parts are essentially the same. The apical cells in both are obtuse. de Toni (1889) gives the length of *C. flagelliformis* as 18–20 cm; plants of Stephenson's *C. virgata* are up to 17 cm long. Several specimens of comparable material collected by me are more than 20 cm. in height, whereas *C. flagelliformis* sensu Levring has a maximum height of 15 cm. The similarity of *C. virgata* sensu Stephenson to the true *C. flagelliformis* (Suhr) Kütz. therefore seems obvious. If Suhr's (1840) original description of *flagelliformis* is also considered, one sees its applicability to Kützing's figure (Kützing, 1853) of *C. virgata* (Ag.) Kütz. One is thus led to the hypothesis that Kützing's *C. flagelliformis* is merely a longer form of his *C. virgata.*

My observations of *Cladophora* plants in which all the branches dilate upwards, show that there are stunted forms and elongated ones which I am unable to distinguish on morphological grounds as distinct species. The stunted forms in my opinion are typical of *C. virgata* (Ag.) Kütz., and the elongated forms could be referred to *C. flagelliformis* (Suhr) Kütz. Apart from Levring's account of *C. flagelliformis* I can find nothing in the earlier descriptions to show any inherent difference between *C. virgata* and *C. flagelliformis* except one of relative size, and Kützing's implication of an associated distinction in branching. My observations are that the branching habits of smaller and larger plants show no consistent difference such as that suggested by Kützing.

Stephenson's material named *C. flagelliformis* on the basis of Levring's description diverges too far from earlier descriptions to be accepted as this species; but in my opinion it is clearly related to *Cladophora capensis* (Ag.) Kütz. and the two appear to me to be included in the range of variation of one species.

The conclusion reached is that *C. flagelliformis* (Suhr) Kütz. is a synonym of *C. virgata* (Ag.) Kütz., the latter being the prior name by which the species should be known. *C. flagelliformis* sensu Levring is I suggest a synonym of *C. capensis* (Ag.) Kütz.* A third species *C. isaacii*, identified by an earlier investigator as *C. capensis*, is distinguished.

Descriptions are appended of the three species that have been recognised.

(1) **Cladophora virgata** (Ag.) Kütz., Sp. Alg. p. 388, 1843.
Conferva virgata Ag., Syst. Alg. p. 119, 1824.
Cladophora flagelliformis (Suhr) Kütz., Sp. Alg. p. 388, 1843.

Holdfast a rather small knob-like structure which is somewhat flattened at its base to form a disc up to 3 mm in diameter. The whole is formed from the compacting of the main filaments at their bases and is surrounded by a hyaline sheath which is continuous with the walls of the filaments (Fig. 1a). The compact holdfast is not easily dissected owing to the presence of the sheath. *Erect System*, (i) *Branching:* Several closely compacted filaments arise from the holdfast and these soon diverge to form elongated filaments which produce short branches almost throughout their length. These short branches diverge strongly from the line of the main filaments and are usually naked (Fig. 1b). Elongated branches arise occasionally in the lower parts, but are mostly

* Dr. Papenfuss has kindly confirmed in a private communication that *C. virgata* (Ag.) Kütz. and *C. flagelliformis* (Suhr) Kütz. are synonymous. He states that the material seen and described by Levring was wrongly circulated by Suhr as examples of *Conferva flagelliformis* Suhr, but is in fact representative of a new species. At the moment I am not convinced that *C. flagelliformis* sensu Levring is a new species.

produced in the upper parts; the upper branches may again branch in a di- or trichotomous manner in which case they are all flagelliform (Pl. 1). Branching throughout the plants is typically opposite but may be alternate or in whorls of three or four. All branches dilate towards their apices. Many of the flagelliform branches become truncate by loss of their terminal portions. Basal cells of branches tend to coalesce slightly at their origins but never appear to arise from the centre of a cell, except perhaps near the holdfast. (ii) *Cells of the Filaments:* Near the holdfast these are clearly defined and are two to four times longer than broad but may occasionally be as much as six times as long as their diameter. In the upper parts all the cells have more or less the same length and breadth (Fig. 1c). The cell contents throughout the plant are dense and opaque, and specimens regarded as comparable in the field are very dark green with a bluish shade. Apical cells of branches have obtuse tips and are usually more or less umbonate (Fig. 2).

(2) **Cladophora capensis** (Ag.) Kütz. Sp. Alg. p. 421, 1849.
Conferva capensis Ag., Syst. Alg. p. 118, 1824.
Cladophora ecklonii (Rud.) Kütz., Phyc. Gen. p. 270, 1843.
Conferva ecklonii Rud., Linnaea 6, p. 180, 1831; Suhr, Flora 17, p. 741, 1834.

Holdfast: This is a matted cushion up to 1·5 cm. in diameter and formed of branched rhizoids which usually contain chlorophyll. The plant is easily dissected into main filaments with rhizoids below (Fig. 3). *Erect System,* (i) *Branching:* This ranges from near dichotomy (Fig. 4) to distinct main filaments bearing fascicles of short branches throughout their length (Pl. 2). Generally branching is alternate, but sometimes the branches arise in whorls of two or more. Longer branches characteristically arise in the lower parts of the plants, but they may occur in the upper parts in which case they may become somewhat dilated and frequently dissolute towards their apices (Fig. 5a). Such dilation frequently results in these branches becoming thicker than the main filaments in their lower parts. The ultimate branchings are often dichotomous. Other branches taper gradually towards their apices (Fig. 5b). Basal cells of branches tend more or less markedly to coalesce with cells of parent filaments (Fig. 5c) especially in the lower parts of the plants where basal cells of branches appear to originate from the centre of a cell, (Fig. 5d). All branches tend to be appressed to their parent filaments (Pl. 2). (ii) *Cells of the Filaments:* Cells near the holdfast are four to six times longer than they are broad but may be up to ten times longer. In the upper parts of the plants the cells are two to four times longer than broad but may be almost as broad as they are long in branches which dilate upwards. Apical cells vary somewhat in shape but they are usually two to three times longer than broad and either umbonately acute, especially in dilated branches (Fig. 5e & f), or more or less acuminate (Fig. 6). The hyaline cap terminating branches is always thick and may be as much as eight times thicker than the lateral walls. A feature not always apparent is the presence of inflated cells of a clavate or fusiform shape scattered throughout the length of the plant. Some branches may consist of one or two such cells (Fig. 7).

Plants of this species may be up to 15 cm high, but if growing in habitats where they are uncovered at low tide and subject to strong wave action they are generally shorter with a strong tendency towards the dichotomous habit. Such plants tend to be more robust and less branched than those growing in pools. Specimens with a fasciculate habit are reminiscent of Kützing's (1854) figures of *C. neesiorum*, *C. humilis* and *C. ramosissima*, all of which de Toni (1889) regards as synonymous. *Cladophora capensis* is, however, coarser than *C. neesiorum.*

Levring (1938) and Papenfuss (1940) have stated that *C. capensis* and *C. ecklonii* are synonymous. In my opinion, *C. flagelliformis* sensu Levring is also the same species.

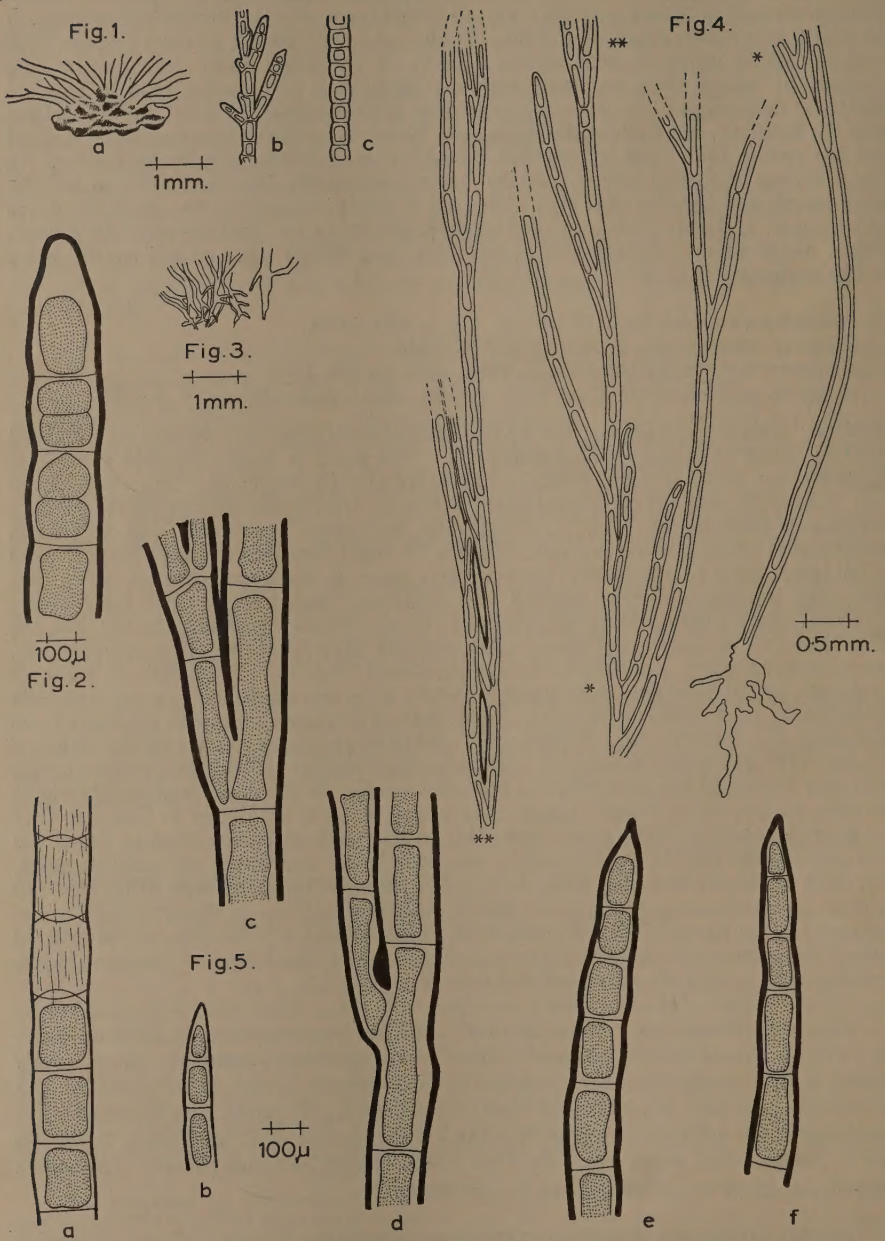
Fig.1.
a
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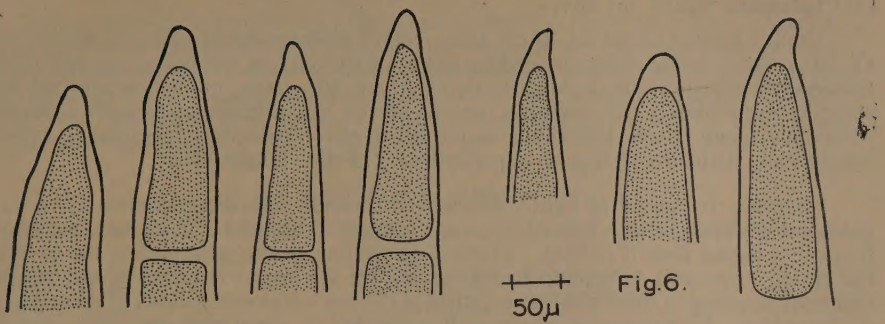


Fig.6.

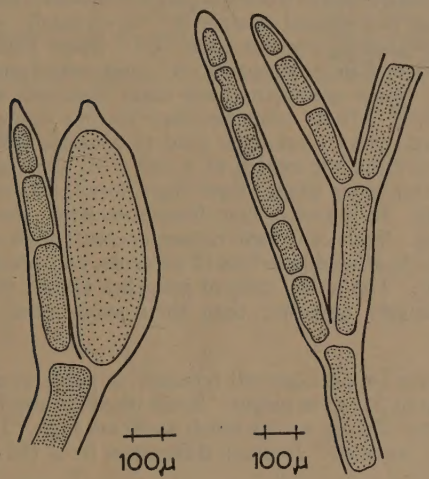


Fig.7.

Fig.8.

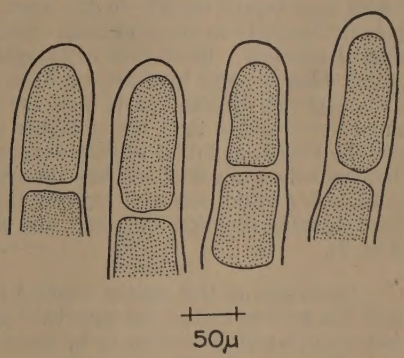


Fig. 9.

FIG. 1.—*C. virgata* (Ag.) Kütz. *a*, Hyaline disc forming holdfast; *b*, Short divergent naked branchlets; *c*, Cells near apex of branch.

FIG. 2.—Terminal portion of a branch of *C. virgata* (Ag.) Kütz. showing the obtuse tip of the apical cell.

FIG. 3.—Rhizoids at the base of the main filaments of *C. capensis* (Ag.) Kütz.

FIG. 4.—Near dichotomy of branches of *C. capensis* (Ag.) Kütz.

FIG. 5.—*C. capensis* (Ag.) Kütz. *a*, Dilated branch with dissolute terminal portion; *b*, Tapering branch with subacuminate tip; *c*, Coalescence of basal cell of branch with parent filament in upper portion of plant; *d*, Basal cell of branch in lower portion of plant; *e* and *f*, Apices of dilated branches.

FIG. 6.—Forms of apical cells in *C. capensis* (Ag.) Kütz.

FIG. 7.—Branchlet consisting of a single inflated cell in *C. capensis* (Ag.) Kütz.

FIG. 8.—Short divergent branches of *C. isaacii* sp. nov.

FIG. 9.—Bluntly rounded apices of branches of *C. isaacii* sp. nov.

(3) **Cladophora isaacii** sp. nov.

Thallus erectus usque ad 40 cm altus, colore olivaceo-viride; fila primaria inferne ad 200 μ lata; ramis elongatis, ordine tertia quoquoversum ramosis; ramulis ultimis brevioribus, gracilioribus, subdivaricatis usque ad 80 μ latis, quoquoversum vel subsecundo exeuntibus; filis omnibus apices versus vix attenuatis; apicibus obtusis, rotundatis quam muris lateralibus usque ad 3–plo crassioribus incrassatis; cellulis inferioribus diametro 2–6–plo, superioribus 2–3–plo longioribus.

Holdfast: is formed of tightly interwoven rhizoids with dense contents of a dark green colour when fresh. The whole is not more than about 4 mm in diameter and is frequently higher than it is wide. There is no hyaline sheath surrounding the holdfast but closely appressed decurrent rhizoids arise from the lowest branches of the primary filaments resulting in some matting together of the main filaments below. *Erect System,* (i) *Branching:* Branches arise more or less spirally or sometimes oppositely and the ultimate branchlets are frequently short and divergent from the parent filaments (Fig. 8). There is a tendency for branchlets to arise in a secund manner (Pl. 3), especially in the upper parts. Almost all branches taper slightly towards their tips. Main filaments and primary branches are elongated and end in a comparatively long naked portion which also tapers slightly to the apex. Some specimens have main filaments which branch furcately in their ultimate portions. These branches may become somewhat dilated upwards. Basal cells of elongated primary branches tend to coalesce with the parent filament and may appear to arise from the centre of a cell. (ii) *Cells of the Filaments:* In the basal parts these are four to six times longer than broad, and two to three times longer than broad higher up. In branches that dilate somewhat, the cells may be almost as broad as they are long. Such cells have denser contents than other filament cells and sometimes have become hyaline due to loss of contents, an occurrence presumably associated with reproduction. The apical cells of branches almost always have bluntly rounded tips and are scarcely narrower than their subterminal cells (Fig. 9).

Specimens of this species which I have found occurred typically in pools at about mid-tide level or higher and have been up to 25 cm in height. Some plants in the Tyson collection, which I consider to be the same species, are as much as 40 cm high. In the past this species has been mistaken for *C. capensis.* Its main differences from the latter species are given below.

Comparison of the Three Species.

C. virgata is easily identified by its bluish-green colour, its disc holdfast and its branching habit, the branches usually being opposite or whorled with all branches dilating upwards and terminating in distinctive umbonately thickened apices. On the other hand, *C. capensis* and *C. isaacii* are much more similar in appearance and more likely to be confused. The main differences are seen in their branching habits. In *C. capensis* the branching is variable but the branchlets tend to be closely appressed to the parent filaments and taper gradually to rather acuminate apices with relatively thick end walls. The apical cell becomes more rapidly narrow towards its tip. In *C. isaacii* the shorter branches diverge from the parent filaments and all branches taper very little to bluntly rounded apices, whose end walls are thin in comparison with those of *C. capensis.* Moreover the apical cells of the latter species are longer relative to their breadth than those of *C. isaacii.* Inflated cells, scattered throughout the length of the plant, are common in *C. capensis* but have not yet been observed in *C. isaacii.* Plants of *C. capensis* are coarser than those of *C. isaacii* in the upper parts (cfr. Plates 2 & 3) and are generally much more rigid. The colour of the latter species is an olive green whereas *C. capensis* is a bright green. A further distinction is apparent in that *C. capensis* in drying sticks to paper only slightly but *C. isaacii* adheres well.

SUMMARY.

It is shown that *C. virgata* (Ag.) Kütz. and *C. flagelliformis* (Suhr) Kütz. are synonymous, the former being the correct name. The account of *C. flagelliformis* by Levring (1938) is discussed and shown to refer to material not conforming with this species. It is suggested that *C. flagelliformis* in the sense used by Levring, Stephenson and Papenfuss (Tyson collection) is synonymous with *C. capensis* (Ag.) Kütz. A third species, *C. isaacii*, is discussed and described as new.

LITERATURE CITED.

ARESCHOUG, J. E. (1851)..... " Phyceae Capensis ", Venia Amplis Philos. Facult. Upsaliensis. p. 9.
DE TONI, J. B. (1889)..... " Sylloge Algarum ", Vol. 1, p. 331.
Kützing, F. (1849)..... " Species Algarum ", p. 421, Leipzig.
Kützing, F. (1853)..... " Tabulae Phyceae ", T. 77.
Kützing, F. (1854)..... " Tabulae Phyceae ", T. 4, 5.
LEVRING, T. (1938)..... " Verzeichnis Einiger Chlorophyceen und Phaeophyceen von Süd-Afrika ", Lunds Univ. Arsskr. N. F. Avd. 2, 34, 9.
STEPHENSON, T. A. S. (1944)..... " The Constitution of the Intertidal Fauna and Flora of S. Africa, Pt. ii ", Ann. Natal Mus. 10, p. 341.
SUHR, J. H. VON (1840)..... " Beitrage zur Algenkunde ", Flora, 23, p. 294.

PLATE 1.—Habit of upper portion of *C. virgata* (Ag.) Kütz.. showing elongated flagelliform branches.

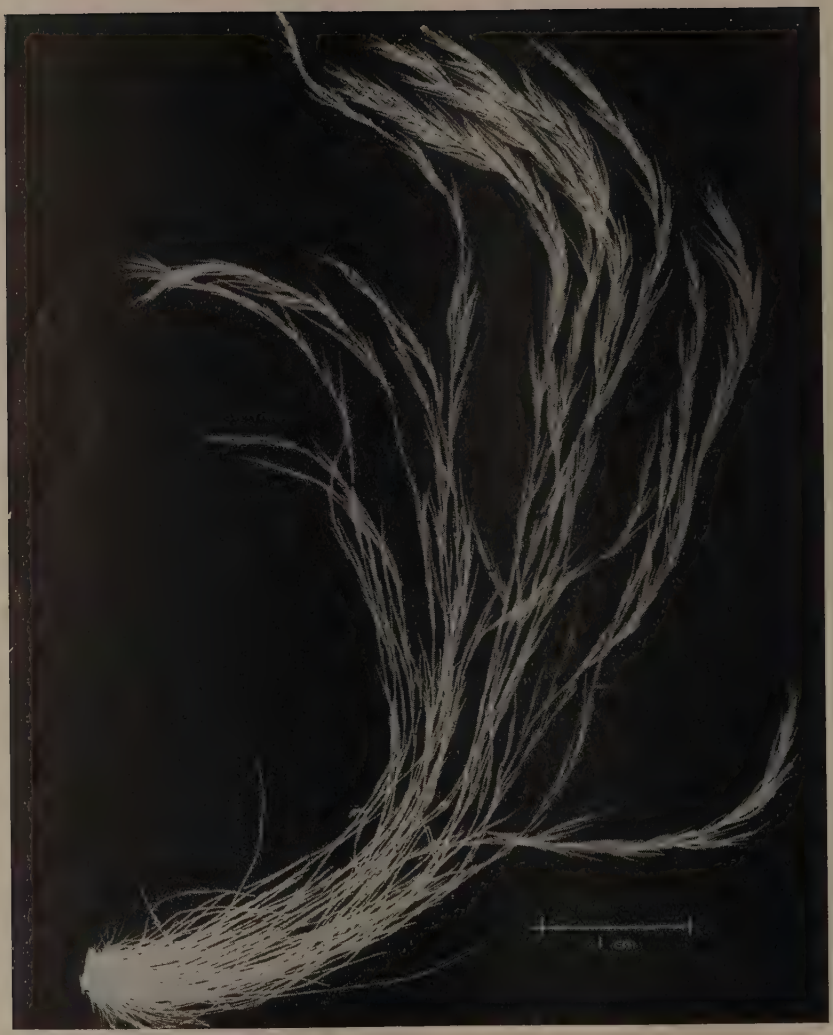


PLATE 2.—Habit of some specimens of *C. capensis* (Ag.) Kütz. showing several main filaments bearing fascicles of short branches throughout their length.

PLATE 3.—Habit of *C. isaacii*, showing secund arrangement of branchlets in upper parts.

Notes on Aristothamnion purpuriferum (Kütz.) J. Ag.

By

R. H. Simons.

INTRODUCTION.

This South African seaweed is listed by Stephenson (8), and known by local phycologists, as *Pleonosporium purpuriferum* (Kütz.) de Toni. In Kylin's (6) recent publication on the genera of the Rhodophyceae it appears as *Aristothamnion purpuriferum*, by which name I shall discuss it. The purpose of the present paper is to record the occurrence of tetrasporangia and to discuss this plant's taxonomy.

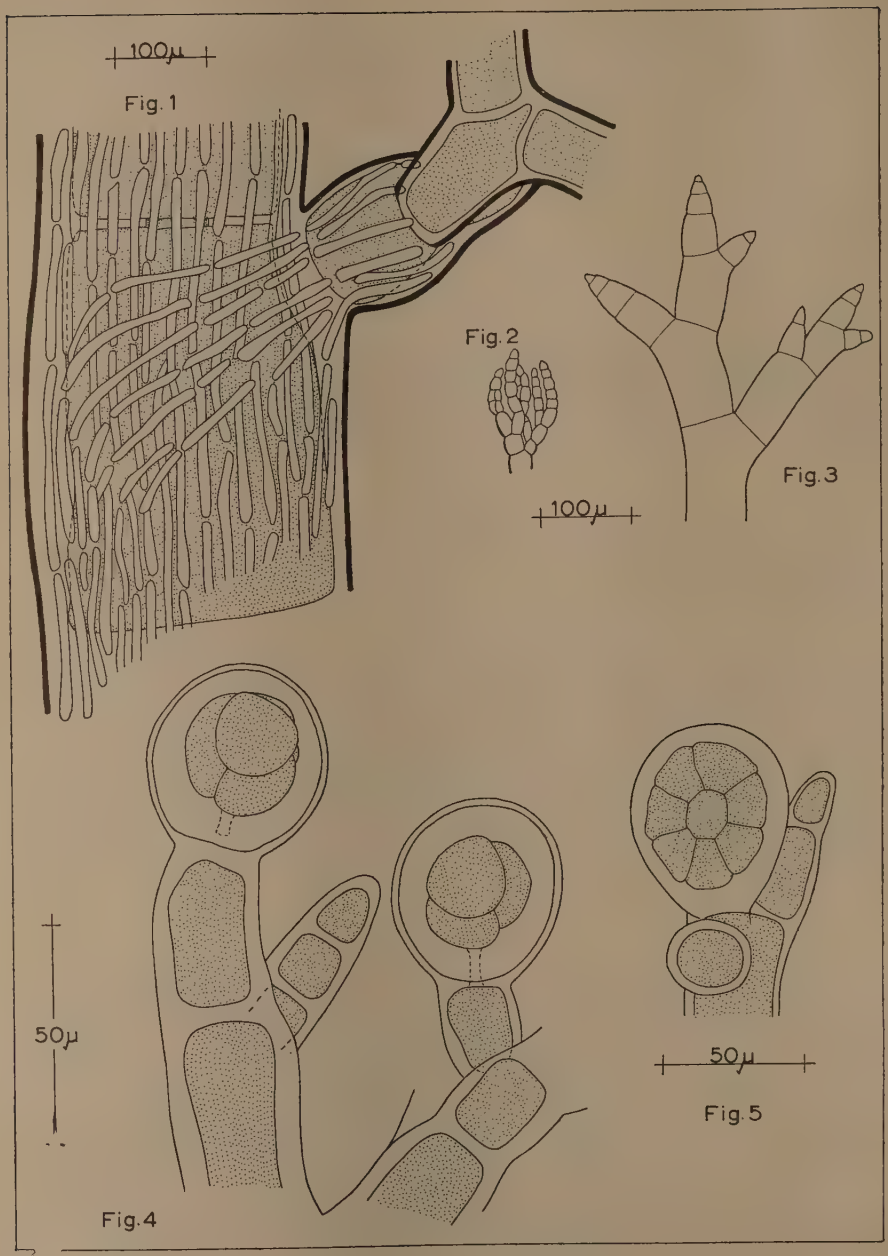
MORPHOLOGY.

A full description of the morphology of *A. purpuriferum* has been given by Westbrook (9) who regarded it as a species of *Callithamnion*. For purposes of clarity its salient features are given here.

It is one of the species of Ceramiaceae with a well developed cortex made up of decurrent filaments arising at the lower ends of branches (Fig. 1). The ultimate branches are always uncorticated and two types can be distinguished—those of limited growth and those of unlimited growth. The apices of branches of unlimited growth have corymbosely clustered and inflexed branchlets (Fig. 2), but branches of limited growth have branchlets which spread and rapidly taper to acute apices (Fig. 3). The plants are typically dioecious with a separate sporophytic phase. Female organs are produced laterally on intercalary cells near the apices of branches of unlimited growth, whereas male organs occur laterally on intercalary cells of branches of limited growth. Both poly- and tetrasporangia have been recorded as lateral structures on intercalary cells of branches of limited growth.

OBSERVATIONS.

In the many male and female plants I have examined the reproductive organs occurred in the positions noted above. On certain plants I have found polysporangia also occupying the position described for them. Such plants have borne no other type of reproductive structure. The only tetrasporangia observed have occupied an unexpected position. These arise on occasional plants bearing numerous female structures in all stages of development up to maturity and appearing therefore to be female plants. In these specimens the apical cell of a branch of unlimited growth is occasionally replaced by a subglobose swelling containing four tetrahedrally arranged spores (Fig. 4). The wall of such a sporangium is very thick and a distinct pit-connection is visible between the subtending vegetative cell and the spore group. These sporangia are nearly twice as wide as their subtending cells, but narrower than a mature polysporangium (Fig. 5). Tetrasporangia have a diameter of 25–35 μ; an average sized polysporangium is 50 μ in diameter.


100μ
Fig. 1
Fig. 2
100μ
Fig. 3
50μ
Fig. 4
50μ
Fig. 5

Further sporangium-like bodies with undivided contents are encountered in exactly similar positions to the tetrasporangia described above, but whether they are mature monosporangia or immature tetrasporangia I have not been able to ascertain. They appear to be more numerous than tetrasporangia but nevertheless occur only occasionally. Cystocarps have been observed arising lower down on branches terminating in either of these sporangial structures.

RECORDS OF " ABNORMAL " TETRASPORANGIA AND THEIR SIGNIFICANCE IN THE CERAMIACEAE.

The occurrence of the tetrasporangia is " abnormal " in that they are produced on apparently female plants. Records of such occurrence are not uncommon in the Ceramiaceae, particularly in species of *Callithamnion*. Westbrook (10) records a single tetrasporangium arising terminally on a branch of a female plant of *C. tetricum*, an " abnormality " apparently similar to that now recorded for *A. purpuriferum*. The normal position of tetrasporangia of *C. tetricum* is on separate sporophytic plants where they are borne laterally on branches of limited growth, as are the polysporangia of *A. purpuriferum*. Westbrook did not investigate the cytology of the " abnormal " sporangia on *C. tetricum* but seemed to think that no reduction division accompanied the formation of their spores. She referred, however, to an account of *C. brachiatum* by Mathias (7) of similar " abnormal " sporangia in which there was meiosis. Drew (Fritsch 5) found reduction division taking place in the formation of tetraspores produced on plants of *Spermothamnion turneri*—a related species—bearing functional female organs. It is possible that conclusions similar to Drew's may result from cytological study of the " abnormal " sporangia of *C. tetricum* and *A. purpuriferum*.

The significance of the occurrence of reduction division in the production of such " abnormal " spores is that the plants bearing them are diploid and the carpospores resulting from the fertilisation of procarps arising on the same plants should be triploid. Drew found evidence of triploid carpospores developing on plants of *S. turneri* which also bore tetrasporangia. It is obvious that until the cytology of the " abnormal " sporangia in *A. purpuriferum* is investigated no conclusions may be drawn as to whether the plants producing them are haploid or diploid.

OCCURRENCE OF TETRASPORES IN *A. PURPURIFERUM* IN RELATION TO ITS TAXONOMY.

There are apparently only two other references to the occurrence of tetrasporangia in *A. purpuriferum* both of which seem attributable to de Toni (3). Baardseth (2) questions the validity of de Toni's claim that tetrasporangia are produced by this plant;

FIG. 1.—Origin of cortical filaments.

FIG. 2.—Ultimate branchlets of branch of unlimited growth.

FIG. 3.—Ultimate branchlets of branch of limited growth.

FIG. 4.—Tetrasporangia terminating ultimate branchlets.

FIG. 5.—Mature polysporangium above and developing polysporangium below on a cell of a branch of limited growth.

he could not find tetrasporangia in material he examined, and noted that this had also been the experience of Papenfuss, with whom he had communicated privately on this matter. Westbrook (9) also mentions the occurrence of tetrasporangia in this species but she did not find any in the plants she examined. Since she did not name her authority for this statement it seems likely that she accepted de Toni's record. Thus the evidence of most investigators of this plant is that normal tetrasporangia are not produced.

The absence of normal tetrasporangia in this species is taxonomically important because this was the character used originally by Agardh to separate the genus *Aristothamnion* from *Callithamnion*. Sporophytic plants of species of *Callithamnion* characteristically produce tetrasporangia in the asexual phase, whereas in *Aristothamnion* it is only polysporangia that are produced by plants of this phase. In all other respects the two genera are indistinguishable. Apparently de Toni regarded the production of polysporangia in members of the Ceramiaceae as taxonomically fundamental and placed all species with this feature in his genus *Pleonosporium*. Westbrook (9), however, did not share this view but placed more emphasis on the characters of male and female structures. Because the position and structure of the male and female organs are identical in *A. purpuriferum* and *Callithamnion* spp., but quite unlike those of *Pleonosporium* spp., Westbrook placed *A. purpuriferum* in the genus *Callithamnion*.

Feldman-Mazoyer (4) in her treatise on the Ceramiaceae of the Mediterranean, concluded that the structure and development of the female organs were the only reliable characters indicating relationships and leading to a natural classification within the family. This is partly in agreement with Westbrook's view and seems the most logical. Her conclusion as to the relationship of *A. purpuriferum* with *Callithamnion* was therefore justified. But she was under the impression that normal tetrasporangia were produced by this plant and there seemed no reason for separating it from the genus *Callithamnion* as was proposed by Agardh (1).

CONCLUSIONS.

My record of tetrasporangia in *A. purpuriferum* is the first that has been made since de Toni's (3). The cytology of these structures has not been adequately investigated but they are " abnormal " in that they occur on plants bearing functional female organs. It would seem from the evidence of most investigators that sporophytic plants produce only polysporangia, and this character remains a point of difference between the genera *Aristothamnion* and *Callithamnion*. Although polysporangia are recorded for various species of *Callithamnion* they are accompanied by tetrasporangia (Fritsch 5, p. 729). Even if the tetrasporangia that I have described above should prove to arise on diploid plants forming a sporophytic phase of this species, their situation is not typical of species of *Callithamnion*. In this connection it should be noted that the tetrasporangia recorded by Mathias (7) as arising on sexual plants of *C. brachiatum* occurred in the lateral position normal for this genus. Also, Westbrook (10) found lateral tetrasporangia on the same female plant of *C. tetricum* which bore a single terminal tetrasporangium. It therefore seems appropriate at this stage to retain the name *Aristothamnion purpuriferum* (Kütz.) J. Ag. for the present species.

SUMMARY.

A new record of tetrasporangia in *Aristothamnion purpuriferum* is given. These tetrasporangia are abnormal in that they occur on individuals bearing mature female organs. Their morphological and taxonomic significance is discussed and it is concluded that in the present state of our knowledge this plant should be known as *A. purpuriferum* (Kütz.) J. Ag.

LITERATURE CITED.

1. AGARDH, J. G..... Anal. Alg. ii, 44, 1892.
2. BAARDSETH, E..... The Marine Algae of Tristan da Cunha. Norske Vidensk. Akad., Oslo 95, 1941.
3. DE TONI, J. B..... Syll. Alg. vi, 469, 1924.
4. FELDMAN-MAZOYER, G..... Recherches sur les Ceramiacees de la Mediterranee Occidentale. Alger. 237, 1940.
5. FRITSCH, F. E..... The Structure and Reproduction of the Algae. ii, 723, 1945.
6. KYLIN, H..... Die Gattungen der Rhodophyceen. Lund. 383, 1954.
7. MATHIAS, W. T..... The Cytology of *Callithamnion brachiatum* Bonnem. Publ. of Hartley Bot. Lab. 5, 20, 1928.
8. STEPHENSON, T. A..... The Constitution of the Intertidal Fauna and Flora of South Africa. Pt. iii. Ann. Natal Mus. xi, 307, 1948.
9. WESTBROOK, M. A..... *Callithamnion purpuriferum* J. G. Ag. Jour. Bot., 65, 161, 1927.
10. WESTBROOK, M. A..... *Callithamnion tetricum* (Dillw.) Ag. Jour. Bot., 68, 193, 1930.

Virus Diseases of Lupins.

By

Patricia J. Klesser.

Although virus infections of lupins have been known in South Africa for several years, no previous attempt has been made to identify the causal organisms. A preliminary report was published in 1953 (3).

REVIEW OF LITERATURE.

The first record of viroses of lupins came from Germany in 1929 when Merkel (6) reported a pock mosaic and a speckle mosaic of yellow lupins.

Mastenbroek (5) described in detail what he considered to be the same virus. It was found to be seedborne in yellow lupin and only rarely transmissible to beans. He named it *Lupinus* virus 1.

In 1934, Neill, Brien and Chamberlain (7) described " Sore-shin " in New Zealand, and Richter (9) found an unidentified disease in Germany, both of which were later proved to be caused by the pea mosaic virus (1). Further work on this virus in lupins was done by Norris (8).

Kohler (4) reported the Lupinenbraüne virus, later found to be the cucumber mosaic virus. In 1936 Spierenberg (10) in Holland, described a disorder, also later proved to be cucumber mosaic.

Weimer (11) described two viruses found in *L. angustifolius*, but does not confirm their identity. Neither of them is sap transmissible to lupins.

METHODS AND MATERIALS.

Plants with suspected virus infections were collected from different parts of the Union.

The standard test plants used were: *Phaseolus vulgaris* var. Canadian Wonder, *Vicia faba* and *Pisum sativum* var. Greenfeast. In addition, about 30 other legumes, and some plants belonging to the *Solanaceae* were used in susceptibility tests.

Aphis craccivora was used for the insect transmission tests, but it is not necessarily the natural vector.

Mechanical sap transmission was aided by the use of carborundum powder, and the methods of Johnson and Grant (2) were used for the physical property tests.

This report deals with five viruses, and at the end of each section, there is a discussion on the relationship of the viruses concerned, and names are suggested for the new ones. These names are only tentatively proposed as no proof of virus identity is available beyond that of symptom and physical property resemblances.

VIRUSES FOUND OCCURRING NATURALLY ON LUPINS.

Host Plant.	*Virus.*
Lupinus affinis	Lupin virus A. Pea mosaic virus 4.
L. albus	Lupin virus A. Lupin virus B. Lupin virus C. Bean yellow mosaic virus. Pea mosaic virus 4.
L. angustifolius	Lupin virus A. Lupin virus B. Lupin virus C. Bean yellow mosaic virus. Pea mosaic virus 4.
L. luteus	Lupin virus A. Pea mosaic virus 4.
L. mutabilis	Lupin virus A.

Lupins are also susceptible to most other legume viruses when inoculated artificially. With the spotted wilt virus they develop a local necrotic reaction. (See report on pea virus diseases.)

SYMPTOMS FOUND ON LUPINS WHEN NATURALLY INFECTED.

Lupinus affinis with:

1. Lupin virus A.

   The leaves are chlorotic and malformed, and rosetted. The plant is stunted.

2. Pea mosaic virus 4.

   The leaves are chlorotic with necrosis setting in, and they are much reduced in size. There are necrotic stem streaks. The plant is stunted.

Lupinus albus with:

1. Lupin virus A.

   A top necrosis usually causes the collapse of the growing point. Secondary shoots have chlorotic, malformed leaves and they are rosetted and stunted.

2. Lupin virus B.

   Most leaves are small, malformed and chlorotic. Many drop and there may be a complete defoliation. There are necrotic stem streaks.

3. Lupin virus C.

   The leaves have chlorotic spots and possibly necrotic specks. They remain folded and have wavy margins. The plant is stunted.

4. Bean yellow mosaic virus.

   The leaves are mottled, they remain folded, and have wavy margins and a general puckering. There is a severe rosette and the plant is stunted. (Fig. 4a).

5. Pea mosaic virus 4.

   There is a vein clearing, chlorotic ringspotting or mottle. The plant may be rosetted.

Lupinus angustifolius with:

1. Lupin virus A.

   The leaves are chlorotic and malformed, and the plant is stunted and rosetted.

2. Lupin virus B.

   The leaves are small and have necrotic specks. Most leaves drop. There are necrotic stem streaks.

3. Lupin virus C.

   The leaves have a chlorotic speck mosaic and they are very small and crinkled. The plant is extremely rosetted and stunted. (Fig. 3a).

4. Bean yellow mosaic virus.

   The leaves are mottled and there may be necrotic stem streaks which cause the collapse of the growing point. The leaves of the secondary shoots are vividly mottled, rolled and malformed.

5. Pea mosaic virus 4.

   There is a mottle on the leaves with possibly a veinal necrosis which results in the collapse of the plant.

Lupinus luteus with:

1. Lupin virus A.

   The leaves are chlorotic and malformed and the plant is rosetted and stunted.

2. Lupin virus B.

   The leaves are mottled and puckered and the plant is rosetted.

Lupinus mutabilis with:

1. Lupin virus A.

   There is a general chlorosis of the leaves which are also malformed, and rosetted. The plant is stunted.

I. Lupin Virus A.

Physical properties: Thermal inactivation point, 58–60°C. Longevity *in vitro*, 2–3 days. Dilution end point, 1 : 1000.

Transmission: Mechanical sap inoculation. *Aphis craccivora.*

Host range: *Cicer arietinum* L., *Crotalaria juncea* L., *C. spectabilis* Roth., *Glycine max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L. var. Sweet, *L. albus* L. var. Bitter, *L. angustifolius* L., *L. luteus* L., *L. mutabilis* L., *Medicago lupulina* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus* L., *P. vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *T. pratense* L., *T. repens* L., *Vicia faba* L., *Vigna unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

Reaction of Susceptible Species.

Cicer arietinum.

Local. No reaction.

Systemic. The young leaves develop a few small chlorotic spots.

Crotalaria juncea.

Local. Small necrotic specks develop.

Systemic. After a vein clearing in 24 days the leaves show an irregular chlorosis with dark green islands. The plant is stunted. Several young plants collapsed after a severe necrosis.

C. spectabilis.

Local. In 11 days chlorotic spots with a small central necrotic speck develop. These leaves drop.

Glycine max.

Local. No reaction.

Systemic. A diffuse chlorotic mottle develops.

Lathyrus odoratus.

Local. No reaction.

Systemic. In 21 days there is a vein clearing of the young leaves followed by a streak mottle of leaves which are small and puckered.

Lupinus albus var. Sweet.

Local. There are chlorotic spots in 11 days and the veins may be necrotic in 18 days.

Systemic. There may be a vein clearing soon followed by a necrotic speckling which spreads and results in the collapse of the growing point. Secondary shoots have small leaves which are malformed with crinkled blistered dark green margins and a long narrow base (Fig. 1b.)

L. albus var. Bitter.

Local. No reaction.

Systemic. Necrosis sets in, in 11 days and the plant collapses.

L. angustifolius.

Local. No reaction.

Systemic. The young leaves may show a chlorotic spot mottle and there is a slight malformation with irregular margins. Later necrosis sets in, in the growing point and the plant collapses within three weeks (Fig. 1c).

L. luteus.

Local. No reaction.

Systemic. After 10 days the young leaves develop a chlorotic spotting and later a chlorotic mottle. The leaves remain folded and are almost stringlike and malformed. New leaves are small and rosetted (Fig. 1a).

Medicago lupulina.

Local. No reaction.

Systemic. After a vein clearing there is a chlorotic spot mottle and slight puckering.

Melilotus officinalis.

Local. No reaction.

Systemic. There are streaks which are almost yellow and ringspots which may become necrotic and cause a malformation.

Phaseolus acutifolius.

Local. In 7 days the leaves have chlorotic veins.

Systemic. In 12 days there is a vein clearing of the young leaves. The next leaves to develop are mottled, and still later ones have yellow specks.

P. lunatus.

A symptomless carrier.

P. vulgaris var. Canadian Wonder.

Local. No reaction.

Systemic. The first and second trifoliates have large chlorotic blotches and are reflexed. After 14 days a chlorotic spotting develops on the young leaves which are also rolled. Later leaves develop a mottle with short dark green veinbands. There may be a slight malformation and puckering.

var. Haricot.

Local. In seven to eight days there is a reflexing and the leaves are generally chlorotic.

Systemic. Similar to Canadian Wonder.

vars. Long Tom, Tendergreen and Victor show a reaction similar to Canadian Wonder.

vars. Black Wonder, Idaho Refugee and S.A. Black and White develop large local chlorotic blotches. There is also a severe puckering of the leaves and the plant is stunted.

Pisum sativum.

Local. No reaction.

Systemic. A chlorotic spotting of the young leaves is followed by a mosaic with short dark green veinbands. Later leaves show a marked white vein etching, and they are small. The tendrils are abnormally curled.

Trifolium hybridum.

Local. No reaction.

Systemic. After three weeks a vein clearing develops into alternate chlorotic and green streaks following the veins.

T. incarnatum.

Local. Small chlorotic spots develop.

Systemic. In 18 to 19 days the young leaves develop chlorotic spots. Later leaves have a chlorotic mosaic and are crinkled.

T. pratense.

A symptomless carrier.

T. repens.

A symptomless carrier.

Vicia faba.

Local. No reaction.

Systemic. In 14 days there are chlorotic spots, and a clearing of the veins. Later leaves are mottled.

Vigna unguiculata.

Local. No reaction.

Systemic. A diffuse chlorotic network may develop. The virus can be recovered if symptomless.

Voandzeia subterranea.

Local. No reaction.

Systemic. There may be a diffuse chlorotic spotting, but the virus can be recovered if symptomless.

Natural source of virus: *Lupinus affinis* (Pretoria district), *L. albus*, *L. angustifolius*, *L. luteus*, and *L. mutabilis* (Stellenbosch district).

Identification.

Because of the characteristic reflexing of the bean leaves, this virus is compared with others showing this symptom.

Bean yellow mosaic virus Pierce causes a local necrosis on pea, is non-infectious to cowpea and has a shorter ageing period. Other details are similar, although the host range differs.

A necrotic strain of bean yellow mosaic virus Klesser, has similar physical properties, but induces a local and systemic necrosis of the pea and local necrosis on the cowpea.

Alsike clover mosaic virus 2 Zaumeyer gives a similar reaction on pea, but differs on other hosts.

Osborn's pea virus 2 differs in physical properties, host range and some symptoms.

As no complete correlation can be found, this is considered a new virus, related to the bean yellow mosaic group.

It is named lupin virus A.

2. **Lupin Virus B.**

Physical properties: Thermal inactivation point, 62–65°C. Longevity *in vitro*, 2–3 days. Dilution end point, 1: 100.

Transmission: Mechanical sap inoculation. *Aphis craccivora.*

Host range: *Cicer arietinum* L., *Crotalaria juncea* L., *C. spectabilis* Roth., *Glycine max* (L.) *Merr.*, *Lupinus albus* L. var. Sweet, *L. albus* L. var. Bitter, *L. angustifolius* L., *L. luteus* L., *L. mutabilis* L., *Medicago lupulina* L., M. *sativa* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus* L., *P. vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *T. pratense* L., *T. repens* L., *Vicia faba* L., *Vigna unguiculata* (L.) Walp.

Nicotiana glutinosa L., *N. tabacum* L., *Solanum capsicum* L.

Reaction of Susceptible Species.

Cicer arietinum.

Local. Chlorotic spots with necrotic rings develop.

Systemic. After a vein clearing of the young leaves, later ones are long, narrow and malformed.

Crotalaria juncea.

Local. There are necrotic spots and veins.

Systemic. No reaction.

C. spectabilis.

Local. No reaction.

Systemic. In 11 days there is a clearing of the veins followed by small chlorotic spots, and later, a mottle. Necrosis sets in along the veins causing a puckering of the midrib and malformation. The plant may be severely stunted.

Glycine max.

Local. No reaction.

Systemic. There are chlorotic flecks on the younger leaves.

Lupinus albus var. Sweet.

Local. In nine days there are chlorotic spots and the leaflets collapse.

Systemic. At the same time chlorotic specks develop. On later leaves there is a general chlorosis leaving dark green blisters. The leaflets remain folded and are malformed (Fig. 2b). After a speck necrosis the plant is almost completely defoliated.

L. albus var. Bitter.

Local. No reaction.

Systemic. In 14 days there are chlorotic spots on the young leaves. Later leaves are mottled and stringlike. There is a slight necrosis and the leaves drop.

L. angustifolius.

Local. After a general necrosis the leaves collapse.

Systemic. There is a veinal necrosis of the young leaves, soon followed by necrotic stem streaks, and collapse of the plant (Fig. 2d).

L. luteus.

Local. No reaction.

Systemic. After 10 days there is a vein clearing of the young leaves, which remain folded, with wavy margins. Later leaves are stringlike and chlorotic and the plant is rosetted and stunted (Fig. 2a).

L. mutabilis.

Local. No reaction.

Systemic. Most leaves have irregular chlorotic areas.

Medicago lupulina.

Local. No reaction.

Systemic. A veinal chlorosis of the young leaves develops in 14 days. This becomes general, leaving dark green veinbands. The leaves are reduced, crinkled and puckered along the midrib.

M. sativa.

Local. No reaction.

Systemic. There are isolated chlorotic spots.

Melilotus officinalis.

Local. No reaction.

Systemic. Only a diffuse chlorotic mottle develops.

Phaseolus acutifolius.

Local. In seven days there are necrotic spots and veins on chlorotic leaves.

Systemic. After 12 days there is a vein clearing of the young leaves, and a yellow mottle and malformation of those formed later.

P. lunatus.

Local. No reaction.

Systemic. In 10 days there is a chlorotic network and later a speck mottle. Necrosis may set in, and the leaves become malformed.

P. vulgaris var. Canadian Wonder.

Local. Chlorotic spots with necrotic rings develop in 11 days (Fig. 2c.)

Systemic. There are only isolated chlorotic spots which become a diffuse mottle on later formed leaves. The pods are mottled.

var. Haricot.

Local. There are necrotic specks on chlorotic leaves in seven days.

Systemic. The leaves show a chlorotic mottle and they are elongated. The pods are mottled.

Pisum sativum.

Local. After a general necrosis the leaves collapse.

Systemic. There is a vein chlorosis in six days followed by a mottle and sometimes a marked vein etching. The leaves are crinkled and rosetted. The plant is stunted and collapses from necrosis. The tendrils are tightly curled and twisted.

Trifolium hybridum.

Local. No reaction.

Systemic. In nine days there are chlorotic vein streaks and later a mild streak mottle on all leaves.

T. incarnatum.

Local. There may be necrotic specks.

Systemic. In two weeks the young leaves show a vein clearing. Later leaves have an almost white mosaic and are crinkled and rolled.

T. pratense.

Local. No reaction.

Systemic. After a month most leaves show vivid yellow spots and a mosaic.

T. repens.

A symptomless carrier.

Vicia faba.

Local. No reaction.

Systemic. The young leaves develop small chlorotic spots in seven days and those formed later are mottled. Some malformation occurs, leaving an uneven surface.

Vigna unguiculata.

Local. No reaction.

Systemic. There may be vein clearing and a chlorotic speckle. If symptomless, the virus can still be recovered.

Nicotiana glutinosa.

Local. Chlorotic spots and rings appear in seven days.

Systemic. A week later the young leaves develop chlorotic spots and then a mottle. The leaves are puckered and the plant is stunted.

N. tabacum.

Local. No reaction.

Systemic. The young leaves first develop chlorotic spots and then a mottle.

Solanum capsicum.

Local. No reaction.

Systemic. A chlorotic mottle concentrated at the base of the leaves appears after a month.

Natural source of virus: *Lupinus albus* (Pretoria and Stellenbosch), *L. angustifolius* (Stellenbosch).

IDENTIFICATION.

Apart from the local reaction on the bean this virus shows some resemblance to several others.

Lupin virus B resembles the white clover mosaic virus complex Pierce, in that both cause a systemic chlorosis on the bean with a local and systemic necrosis on the pea. It differs from it in the reaction on the broad bean, and the type of local lesion on the French bean. Physical properties are also different.

Lupin virus B also resembles alsike clover mosaic virus 2 Zaumeyer as both cause a necrotic speckling and severe stunting of the pea, but differs from it in that the latter induces a marked reflexing of the leaves of the bean and there is no local reaction.

In his report on the sweet pea streak viruses Ainsworth mentions one which caused an identical local reaction on the bean viz. chlorotic spots with necrotic rings. Unlike lupin virus B, it also induced a reflexing of the bean leaves and eventual collapse of the plant. It also caused a local and systemic necrosis of the broad bean, and only a chlorosis of the pea.

The two types of bean yellow mosaic virus, viz. the local lesion and severe yellow strains of Zaumeyer, are similar in some respects, too.

The local lesion strain also causes a local reaction followed by a systemic mottle, on the bean, but only local lesions develop on the broad bean and cowpea, whereas the lupin virus B induces a systemic mottle on these hosts. Further, the host range and physical properties are dissimilar.

Like lupin virus B, the severe yellow strain causes a mottle on broad bean, and a mottle and necrosis on some varieties of pea, but unlike it, a systemic necrosis usually develops on the bean. Symptoms on other plants and the physical properties also differ.

The systemic symptoms on *Nicotiana glutinosa* are not unlike those of cucumber mosaic virus but further details are not similar.

Therefore, as there appears to be no complete correlation with any other virus, this is considered a new one. The name suggested is lupin virus B.

3. Lupin Virus C.

Physical properties: Thermal inactivation point, 56–58°C. Longevity *in vitro*, 1–2 days. Dilution end point, 1: 100.

Transmission: Mechanical sap inoculation. *Aphis craccivora.*

Host range: *Crotalaria spectabilis* Roth., *Glycine max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L. var. Sweet, *L. albus* L. var. Bitter, *L. angustifolius* L., *L. luteus* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus* L., *P. vulgaris* L., *Trifolium hybridum* L., *T. incarnatum* L., *T. pratense* L., *Vigna unguiculata* (L.) Walp.

Nicotiana glutinosa L., *N. tabacum* L.

Reaction of Susceptible Species.

Crotalaria spectabilis.

Local. No reaction.

Systemic. The young leaves show chlorotic spots, each with a necrotic centre. Later this becomes a mosaic with dark green veinbands and necrosis setting in in the chlorotic areas. The leaves are slightly reduced in size, and puckered and curled.

Glycine max.

Local. There are necrotic lesions in 12 days.

Systemic. The first trifoliates develop chlorotic flecks with necrotic rings, and soon drop. Most other leaves have vivid chlorotic flecks and later a mosaic with necrotic specks.

Lathyrus odoratus.

Local. No reaction.

Systemic. There is a chlorotic streak mottle.

Lupinus albus var. Sweet.

Local. In nine days chlorotic spots with necrotic centres develop.

Systemic. In twelve days the young leaves show a vein clearing and chlorotic spotting. These leaves are rolled upwards but bent down from the pulvinus like an umbrella (Fig. 3b). They have dark green bands or raised blisters, and are rosetted at the top of the plant. Later necrosis sets in from the growing point, and extends down the stem until the plant collapses.

L. albus var. Bitter.

Local. No reaction.

Systemic. Within 15 days necrosis has caused the collapse of the plant.

L. angustifolius.

Local. No reaction.

Systemic. The leaves show only a diffuse mottling, but they are severely curled and folded. Later necrosis causes the leaves to drop.

L. luteus.

Local. No reaction.

Systemic. There is a vein clearing and spotting of the young leaves in 15 days. Later leaves are small with dark green blisters, and they remain folded. The plant is stunted.

Melilotus officinalis.

Local. No reaction.

Systemic. Chlorotic streaks and rings develop.

Phaseolus acutifolius.

Local. Chlorotic spots with necrotic rings develop.

Systemic. There is a chlorotic spotting.

P. lunatus.

A symptomless carrier.

P. vulgaris var. Canadian Wonder.

Local. Chlorotic spots with a necrotic ring develop in 12 to 13 days.

Systemic. There is a chlorotic mottle.

var. Haricot.

Local. There is a chlorotic spotting in seven days and later the leaves drop.

Systemic. The older trifoliates become long and narrow while the young leaves are malformed with a mottle or broad dark green veinbands.

vars. Idaho Refugee, S.A. Black and White and Tendergreen develop symptoms similar to Canadian Wonder.

Trifolium hybridum.

Local. No reaction.

Systemic. After a vein clearing there are diffuse chlorotic blotches.

T. incarnatum.

Local. Small necrotic lesions develop in 12 days.

Systemic. After a vein clearing there are chlorotic veinbands and a mosaic on the crinkled leaves. The plant is stunted.

T. pratense.

Local. No reaction.

Systemic. There are chlorotic streaks with necrosis setting in, which results in a malformation of the leaves. Some leaves may collapse from the necrosis.

Vigna unguiculata.

Local. In 5 days there are small necrotic spots and the leaves drop.

Systemic. The young leaves also show necrotic spots, and the plant may be completely defoliated.

Nicotiana glutinosa.

Local. Chlorotic spots and patterns develop in 7 days, sometimes with necrotic rings.

Systemic. In 9 days there are chlorotic spots, becoming a mottle on later leaves which are crinkled. The plant is stunted.

N. tabacum.

Local. Necrotic lesions, which enlarge and fuse, appear in 7 days.

Systemic. No reaction.

Natural source of virus: *Lupinus albus* and *Lupinus angustifolius* from Stellenbosch.

Identification.

Like lupin virus B, this virus has similarities with, but cannot be related to, white clover mosaic virus complex Pierce, alsike clover mosaic virus 2 Zaumeyer, the two strains of bean yellow mosaic virus Zaumeyer and cucumber mosaic virus.

It has however, the same characteristic local reaction on the bean as lupin virus B, but differs from it, in its inability to infect either broad bean or pea. The symptoms on lupins are also dissimilar.

Despite the one link with lupin virus B, viz. the local reaction on bean, the virus seems distinct, and is named lupin virus C.

4. **Bean Yellow Mosaic Virus** Pierce.

Physical properties: Thermal inactivation point, 58–60°C. Longevity *in vitro*, 1–2 days. Dilution end point, 1: 1000–1: 2000.

Transmission: Mechanical sap inoculation. *Aphis craccivora.*

Host range: *Arachis hypogaea* L., *Crotalaria juncea* L., *C. spectabilis* Roth., *Glycine max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L. var. Sweet, *L. albus* L. var. Bitter, *L. angustifolius* L., *L. luteus* L., *Medicago lupulina* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus* L., *P. mungo* L., *P. vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *T. pratense* L., *T. repens* L., *Vicia faba* L., *Voandzeia subterranea* Thouars.

Reaction of Susceptible Species.

Arachis hypogaea.

Local. Diffuse chlorotic blotches develop.

Systemic. Most leaves have chlorotic ringspots or patterns, and the plant is stunted.

Crotalaria juncea.

Local. No reaction.

Systemic. The young leaves develop a chlorotic network in 9 days. On later leaves there is a chlorotic mottle with dark green blisters. These leaves are slightly malformed and have wavy margins.

C. spectabilis.

Local. There may be chlorotic spots surrounded by necrotic rings.

Systemic. After a vein clearing of the young leaves in 13 days, later ones develop broad dark green veinbands. The next leaves are mottled.

Glycine max.

Local. Small necrotic lesions develop in 12 days.

Systemic. The young leaves show chlorotic spots or flecks, and on the later ones there is a diffuse mottle.

Lathyrus odoratus.

Local. No reaction.

Systemic. In 3 weeks the young leaves show a vein clearing and chlorotic spotting. The next leaves are rolled and have a mosaic. There is a colour break on the flowers.

Lupinus albus var. Sweet.

Local. There are isolated chlorotic spots in 9 days and the leaves become flaccid.

Systemic. The young leaves remain folded and develop a vein clearing and chlorotic spotting after 16 days. Later leaves are mottled with dark green blisters. They are elongated, malformed and the margins are rolled (Fig. 4b).

L. albus var. Bitter.

Local. No reaction.

Systemic. After a severe necrosis the plant collapses. If secondary shoots develop, they are rosetted with small malformed leaves.

L. angustifolius.

Local. No reaction.

Systemic. The young leaves have a diffuse chlorotic spotting. Later ones are mottled.

L. luteus.

Local. Diffuse chlorotic areas may develop.

Systemic. The young leaves remain folded and have wavy margins, and are chlorotic. Later leaves are stringlike and malformed. The plant is severely rosetted and stunted.

Medicago lupulina.

Local. No reaction.

Systemic. The leaves develop a vein clearing and later a mottle. They are puckered along the midrib.

Melilotus officinalis.

Local. No reaction.

Systemic. After 3–4 weeks most leaves show chlorotic spots, streaks, rings or concentric patterns (Fig. 4c). The old leaves have a chlorotic etching.

Phaseolus acutifolius.

Local. No reaction.

Systemic. The young leaves curl back and have a yellow network. Later leaves are mottled.

P. lunatus.

Local. No reaction.

Systemic. Chlorotic vein slashes may develop in 2–3 weeks or the plant is a symptomless carrier.

P. mungo.

Local. Necrotic veins develop.

Systemic. A limited amount of veinal necrosis may occur.

P. vulgaris var. Canadian Wonder.

Local. No reaction.

Systemic. The young leaves show a marked reflexing from the pulvini and they develop a vein clearing and flecking. Later formed leaves show a mottle and they are slightly malformed with an uneven surface. Most pods have dark green blisters.

var. Haricot.

Local. These leaves bend at right angles to the pulvini, and have diffuse chlorotic areas.

Systemic. The first trifoliates show a marked reflexing and have chlorotic spots. The young leaves are curled, small and mottled, and may have necrosis of the veins. The pods develop dark green blisters with necrosis.

vars. Black Wonder, Idaho Refugee, Long Tom, S.A. Black and White. Tendergreen and Victor develop the typical systemic reaction.

vars. Black Wonder, Idaho Refugee, Long Tom and Tendergreen also show a local chlorosis.

Pisum sativum.

Local. A spreading necrosis causes the leaves to collapse in 14 days.

Systemic. After a vein clearing in 7 days there is a chlorotic spotting followed by a mosaic. The leaves are small, the tendrils are abnormally curled and the plant is stunted.

Trifolium hybridum.

Local. No reaction.

Systemic. After a vein clearing in 15 days the leaves have chlorotic streaks.

T. incarnatum.

Local. No reaction.

Systemic. In 12 days there is a vein clearing and chlorotic spotting. Later leaves develop a mosaic.

T. pratense.

A symptomless carrier.

T. repens.

A symptomless carrier.

Vicia faba.

Local. The leaves may become flaccid and drop.

Systemic. Within 7 days the young leaves develop a spotting or mottle. Later ones are slightly malformed and have chlorotic patterns.

Voandzeia subterranea.

Local. No reaction.

Systemic. A diffuse mottle develops.

Natural source of virus: *Lupinus albus* (Pretoria) and *L. angustifolius* (Stellenbosch).

Identification.

The reflexing of the leaves of *Phaseolus vulgaris* is a characteristic of four viruses or strains.

Only with bean yellow mosaic virus is this reflexing also associated with similarity in physical properties, host range and symptoms on other hosts. This virus is therefore considered to be bean yellow mosaic virus.

5. Pea Mosaic Virus 4 Zaumeyer.

Physical properties: Thermal inactivation point, 60°–65°C. Longevity *in vitro*, 3–4 days. Dilution end point, 1: 5000–1: 10000.

Transmission: Mechanical sap inoculation. *Aphis craccivora.*

Host range: *Crotalaria juncea* L., *C. spectabilis* Roth., *Glycine max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L. var. Sweet, *L. albus* L. var. Bitter, *L. angustifolius* L., *L. luteus* L., *Medicago lupulina* L., *M. sativa* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus* L., *P. vulgaris* L., *Pisum sativum* L., *Trifolium fragiferum* L., *T. hybridum* L., *T. incarnatum* L., *T. pratense* L., *T. repens* L., *Vicia faba* L., *Vigna unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

Reaction of Susceptible Species.

Crotalaria juncea.

Local. No reaction.

Systemic. After 2 weeks there is a mosaic with irregular chlorotic areas and dark green blisters. Later leaves are malformed and stringlike, and the plant is stunted.

C. spectabilis.

Local. Chlorotic spots with small necrotic centres develop in 10–11 days.

Systemic. The young leaves develop chlorotic spots. The next formed are chlorotic with almost white streaks and dark green blisters. There is a slight malformation.

Glycine max.

Local. Chlorotic spots develop in 4–5 days.

Systemic. After a month the leaves show a chlorotic spotting. The older ones also have necrotic specks. The plant is stunted.

Lathyrus odoratus.

Local. No reaction.

Systemic. After 3 weeks there are chlorotic veinbands followed by a streak mottle on later leaves.

Lupinus albus var. Sweet.

Local. After 11 days there is a general chlorosis leaving dark green veinbands. The leaves become flaccid and drop.

Systemic. The young leaves develop a vein clearing and remain folded (Fig. 5b). Later leaves show an irregular chlorosis with dark green blisters. They are malformed, elongated or even stringlike, and rolled (Fig. 5d).

L. albus var. Bitter.

Local. No reaction.

Systemic. The plant collapses after a necrosis.

L. *angustifolius.*

Local. No reaction.

Systemic. A diffuse chlorotic mottle develops in 18 days.

L. luteus.

Local. No reaction.

Systemic. In 14–15 days the young leaves show a vein clearing and spotting. Later leaves are small and malformed and have dark green blisters (Fig. 5c). The plant is stunted and rosetted (Fig.5a).

Medicago lupulina.

Local. No reaction.

Systemic. There is a vein clearing and spotting of the young leaves. Later ones have irregular chlorotic areas, and are slightly puckered along the midrib.

M. sativa.

Local. No reaction.

Systemic. The leaves develop diffuse chlorotic spots.

Melilotus officinalis.

Local. No reaction.

Systemic. There may be chlorotic spots or streaks, or the plant may be a symptomless carrier.

Phaseolus acutifolius.

Local. No reaction.

Systemic. The young leaves curl down severely. They are mottled and have dark green blisters. Later leaves have yellow specks.

P. lunatus.

A symptomless carrier.

P. vulgaris var. Canadian Wonder.

Local. No reaction.

Systemic. The centre leaflet of the first trifoliates shows a marked reflexing. Chlorotic spots develop in 12–13 days and on later leaves there is a mottle. The leaves are crinkled.

var. Haricot.

Local. The leaves bend at right angles to the petiole and may have necrotic specks.

Systemic. As for Canadian Wonder, but there is also a malformation of the leaves. There may be a necrosis of the growing point, which results in the collapse of the plant.

vars. Black Wonder, Long Tom, S.A. Black and White, Tendergreen and Victor show similar symptoms to those of Canadian Wonder.

vars. Long Tom and S.A. Black and White also develop a local chlorosis in 3 days.

Pisum sativum.

Local. No reaction.

Systemic. After a preliminary vein clearing and spotting, a diffuse mottle develops (Fig. 5e).

Trifolium fragiferum.

A symptomless carrier.

T. hybridum.

Local. No reaction.

Systemic. The vein clearing is vivid, and is followed by alternate chlorotic and green streaks, with occasional intervenal spots.

T. incarnatum.

Local. No reaction.

Systemic. There is a vein clearing of the young leaves in 14 days. Later leaves develop a mosaic and crinkling. The plant is stunted.

T. pratense.

Local. No reaction.

Systemic. There are chlorotic ringspots and streaks on most leaves. On the younger leaves a veinal necrosis may develop which causes a slight malformation.

T. repens.

Local. No reaction.

Systemic. There is vein clearing after 3 weeks which is followed by chlorotic streaks.

Vicia faba.

Local. No reaction.

Systemic. After 14 days the young leaves develop chlorotic spots, and later leaves have a mosaic. The old leaves show a chlorotic network.

Vigna unguiculata.

A symptomless carrier.

Voandzeia subterranea.

Local. No reaction.

Systemic. There may be a diffuse chlorotic spotting.

Natural source of virus: *Lupinus affinis* (Pretoria and district) *L. albus*, *L. angustifolius* and *L. luteus* (Stellenbosch).

Identification.

Of the viruses causing the characteristic reflexing of the leaves of the bean, most similarity is shown to the pea mosaic virus 4 Zaumeyer, and this virus is considered to be the same, or very closely related to it.

HOST RANGES.

Host Plant.	Lupin Virus A.	Lupin Virus B.	Lupin Virus C.	Bean Yellow Mosaic Virus.	Pea Mosaic Virus 4.
Arachis hypogaea	−	−	−	+	−
Cicer arietinum	+	+	−	−	−
Crotalaria juncea	+	+	−	+	+
C. spectabilis	+	+	+	+	+
Dolichos lablab	−	−	−	−	−
Glycine javanica	−	−	−	−	−
G. max	+	+	+	+	+
Lathyrus odoratus	+		+	+	+
Lupinus albus Sweet	+	+	+	+	+
Bitter	+	+	+	+	+
L. angustifolius	+	+	+	+	+
L. luteus	+	+	+	+	+
L. mutabilis	+	+			
Medicago lupulina	+	+	−	+	+
M. sativa	−	+		−	+
Melilotus officinalis	+	+	+	+	+
Phaseolus acutifolius	+	+	+	+	+
P. lunatus	+	+	+	+	+
P. mungo	−	−	−	+	−
P. vulgaris	+	+	+	+	+
Pisum sativum	+	+	−	+	+
Trifolium fragiferum	−	−			+
T. hybridum	+	+	+	+	+
T. incarnatum	+	+	+	+	+
T. pratense	+	+	+	+	+
T. repens	+	+	−	+	+
Vicia faba	+	+	−	+	+
Vigna sesquipedalis	−	−	−	−	−
V. unguiculata	+	+	+	−	+
Voandzeia subterranea	+	−	−	+	+
Nicotiana glutinosa	−	+	+	−	−
N. tabacum	−	+	+	−	−

PHYSICAL PROPERTIES AND METHODS OF TRANSMISSION.

Virus.	Thermal Inactivation Point.	Longevity *in vitro*.	Dilution End Point.	Transmission.		
				Sap.	Seed.	Aphis.
Lupin virus—						
A	58–60°C	2–3 days	1 : 1000	+	−	+
B	62–65°C	2–3 days	1 : 100	+	−	+
C	56–58°C	1–2 days	1 : 100	+	−	+
Bean yellow mosaic virus	58–60°C	1–2 days	1 : 1000	+	−	+
Pea mosaic virus 4	60–65°C	3–4 days	1 : 5000	+	−	+

SYMPTOMS ON THREE MAIN TEST PLANTS.

Virus.	*Phas. vulgaris.*	*Vicia faba.*	*Pisum sativum.*
Lupin Virus A.....	Local—neg. Syst.—reflex., chl. mot.	Local—neg. Syst.—c.sp., c. mot.	Local—neg. Syst.—c. mot.
Lupin Virus B.....	Local—chl. sp., necr. O. Syst.—chl. spots	Local—neg. Syst.—c. mot., malf.	Local—necrosis. Syst. c. mot., necr.
Lupin Virus C.....	Local—chl. sp., necr. O. Syst.—chl. mot.	Local—neg. Syst.—neg.	Local—neg. Syst.—neg.
Bean Yellow Mosaic Virus	Local—neg. Syst.—reflex., mot., malf.	Local—flaccid. Syst.—c. sp. mos.	Local—necrosis. Syst.—mos., stunt.
Pea Mosaic Virus 4.....	Local—neg. Syst.—reflex., mot.	Local—neg. Syst.—mos.	Local—neg. Syst.—c. mot.

SYMPTOMS ON THREE MAIN *LUPINUS* HOST PLANTS.

Virus.	*L. albus*—Sweet.	*L. angustifolius.*	*L. luteus.*
Lupin Virus A.....	Local—chl. and necr. Syst.—necr.	Local—neg. Syst.—c. mot., necr.	Local —neg. Syst.—c. mot., malf., ros.
Lupin Virus B.....	Local—chl. Syst.—c. mot., necr.	Local—necr. Syst.—necr.	Local—neg. Syst.—c. mot., stringlike.
Lupin Virus C.....	Local—chl. and necr. Syst.—c. mot., necr.	Local—neg. Syst.—c. mot., crinkle	Local—neg. Syst.—dgr. blist., stunt.
Bean Yellow Mosaic Virus	Local—chl. Syst.—c. mot., malf.	Local—neg. Syst.—chl. mot., csp.	Local—chl. Syst.—chl., malf., stunt.
Pea Mosaic Virus 4.....	Local—chl., veinb. Syst.—c. mot., stringlike	Local—neg. Syst.—chl. mot.	Local—neg. Syst.—dgr. blist., stunt.

ABBREVIATIONS USED:—

chl.—chlorosis, chlorotic.
c. mot.—chlorotic mottle.
c. sp.—chlorotic spots.
dgr. blist.—dark green blisters.
malf.—malformation.
mos.—mosaic.
neg.—negative.
necr.—necrosis or necrotic.
reflex.—reflexing.
ros.—rosette.
veinb.—veinbands.
O.—rings.

SUMMARY.

Lupins in South Africa are naturally infected by five viruses:

1. Bean yellow mosaic virus was found on *Lupinus albus* and *L. angustifolius* at Pretoria and Stellenbosch. This is the first report of the presence of this virus in South Africa.

2. Pea mosaic virus 4 was found on *L. affinis*, *L. albus*, *L. angustifolius* and *L. luteus* in the Pretoria district and Stellenbosch. It is also reported for the first time.

3. Lupin virus A was found on *L. affinis*, *L. albus*, *L. angustifolius*, *L. luteus* and *L. mutabilis*. It is possibly related to the bean yellow mosaic virus group.
4. Lupin virus B was found on *L. albus* and *L. angustifolius*. This is apparently a new virus.
5. Lupin virus C was found on *L. albus* and *L. angustifolius*, and also seems to be a distinct entity, possibly related to lupin virus B.

LITERATURE CITED.

1. Chamberlain, E. E. (1935)..... Sore-shin of blue lupins; its identity with pea mosaic. N.Z.J. Agric., 51: 86–92.
2. Johnson, J. and Grant, T. J. (1932) The properties of plant viruses from different host species. Phytophathology, 22: 741–757.
3. Klesser, P. J. (1953)..... Virus diseases of lupins. Farming in S. Africa, Oct. 1953.
4. Köhler, E. (1935)..... Übertragungs versuche mit dem Virus der Lupinenbraune. Angew. Botanik., 17: 277–286.
5. Mastenbroek, C. (1942)..... Enkele veldwaarnemingen over virusziekten van lupine en een onderzoek over haar mozaiekziekte. Tijdschr. Plantenz., 48: 97–118.
6. Merkel, L. (1929)..... Beiträge zur Kenntnis der Mosaikkrankheit der Familie der Papilionaceen. Z. Pflanzenkr., 39: 289–347.
7. Neill, J. C., Brien, R. M., and Chamberlain, E. E. (1934). Soreshin, a virus disease of blue lupins. N.Z.J. Agric., 49: 139–146.
8. Norris, D. O. (1943)..... Pea mosaic on *Lupinus varius* L. and other species in Western Australia. C.S.I.R. Bull. 170.
9. Richter (1934)..... Eine noch nicht aufgeklärte Lupinenkrankheit. Nachrichtenblatt Deuts. Pflanzen D., 14: 81.
10. Spierenberg, Dina (1936)..... Een virusziekte in lupinen. Tijdschr. Plantenz., 42: 71–76.
11. Weimer, J. L. (1950)..... Two virus diseases of blue lupine. Pl. Dis. Reptr., 34: 376–378.

FIG. 1.—LUPIN VIRUS A.

A. *Lupinus luteus*. B. *L. albus*. C. *L. angustifolius*. Artificial infections.

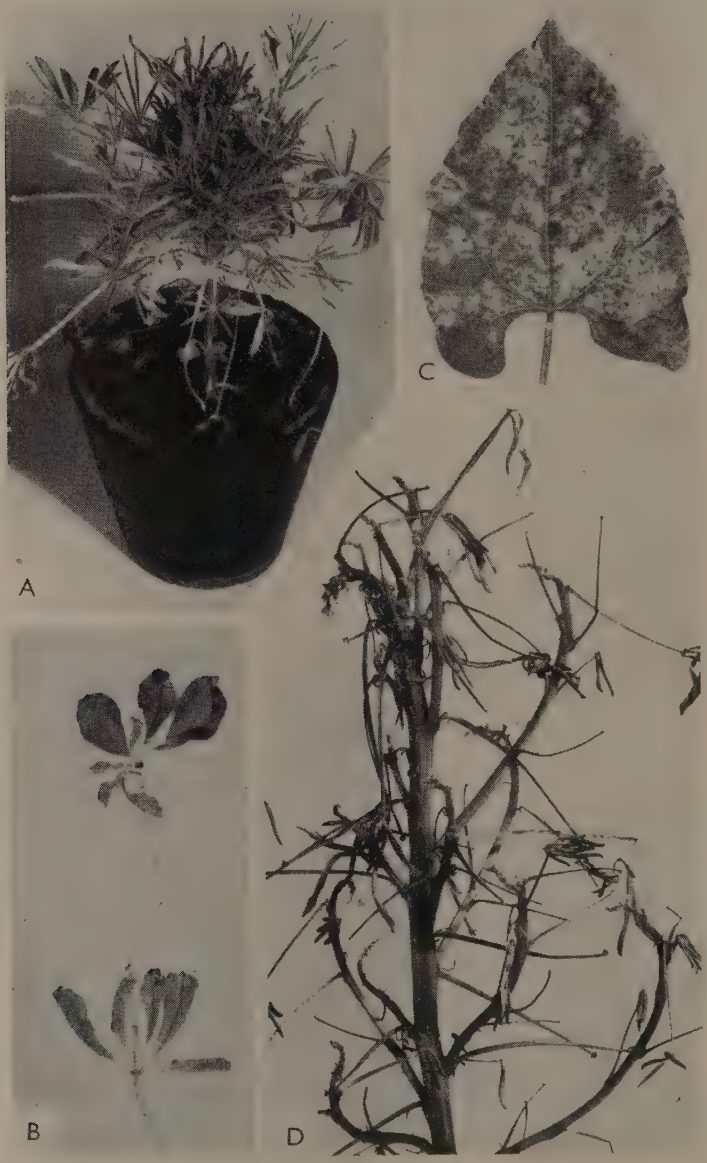


FIG. 2.—LUPIN VIRUS B.

A. *Lupinus luteus*. B. *L. albus*. C. *Phaseolus vulgaris*. Artificial infections. D. *L. angustifolius*—natural infection.

FIG. 3.—LUPIN VIRUS C.

A. *Lupinus angustifolius*—natural infection.

B. *L. albus*—artificial infection.

FIG. 4.—BEAN YELLOW MOSAIC VIRUS.

A. *Lupinus albus*—natural infection.

B. *L. albus*—artificial infection.

C. *Melilotus officinalis*—artificial infection.

FIG. 3.—LUPIN VIRUS C.

A. *Lupinus angustifolius*—natural infection.

B. *L. albus*—artificial infection.

FIG. 4.—BEAN YELLOW MOSAIC VIRUS.

A. *Lupinus albus*—natural infection.
B. *L. albus*—artificial infection.
C. *Melilotus officinalis*—artificial infection.

FIG. 5.—PEA MOSAIC VIRUS 4.

A. and C. *Lupinus luteus*. B. and D. *L. albus*.
E. *Pisum sativum*. Artificial infections.

Virus Diseases of Cowpeas.

By

Patricia J. Klesser.

Virus infections of cowpea, *Vigna unguiculata*, are common in South Africa. There are three types of symptom found in the field viz. a vivid yellow mosaic with dark green blisters; dark green veinbands with necrosis and severe malformation, and a mild veinbanding or mosaic. There is no evidence of seed transmission but *Aphis* species are efficient vectors.

REVIEW OF LITERATURE.

The first reports of mosaic diseases of *Vigna* species were by McClintock (1917), Elliot (1921) and Elmer (1925). Smith (1924) established that a virus causing mosaic symptoms on cowpea was transmissible by a leaf-beetle, *Ceratoma trifurcata*. In 1929, Briant & Martyn recorded the transmission of a mosaic of *V. catjang* in Trinidad; and the following year Smith & Barker described a virus causing severe stunt and chlorosis on cowpeas in Haiti. Yu reported a mosaic of cowpea in China in 1939.

Detailed descriptions of viroses of *Vigna* spp. are given by McLean—a seed-borne mosaic of cowpea (19); Snyder—a seed-borne mosaic of asparagus bean (31); Vasuveda—a mosaic of *V. catjang* in India (32); Yu—cowpea mosaic in China (41); d'Oliviera—cowpea mosaic viruses 1, 2 and 3 (11); Dale—a cowpea mosaic transmitted by a leaf-beetle (8 and 9); Warid & Plakidas—cowpea mosaic viruses with extremely high thermal inactivation points (35) and Anderson (3b). Capoor *et al* described mosaic diseases of *V. catjang* (6) and *V. cylindrica* (7).

Price (21) was the first to report a strain of cucumber mosaic virus (strain Y) which caused a systemic reaction as well as the usual local lesions on cowpea. Later Whipple & Walker (38) described strains 14 and 17, and Fulton found strains A–F on spinach (14). Anderson (3a) recorded yet another strain, also systemic on cowpea.

Sill & Walker (26a and b) when working on the optimum conditions for local lesion production on cowpea with cucumber mosaic virus, found that some lines of cowpeas became systemically infected. Sinclair & Walker (25) determined that this factor was controlled by the mutation of a single gene pair.

Other legumes which can be naturally infected with strains of cucumber mosaic virus are peas and beans, Whipple & Walker (38), and Hagedorn (15), sweet peas, Ainsworth (2) and lima bean, Harter (16).

Several viruses, when inoculated artificially induce local lesions only on cowpea, viz. tobacco ringspot, Wingard (39); tobacco necrosis, Smith & Bald (30); potato calico, Black & Price (4); tomato bushy stunt, Smith (28); alfalfa mosaic 1, Zaumeyer (43) and Black & Price (4); alfalfa mosaic 1A, 1B and 2, Zaumeyer (43) and pea wilt, Johnson (17).

The curly top virus causes severe stunt of the plant and proliferation of the leaves of cowpea, Severin & Henderson (24).

METHODS AND MATERIALS.

The following three viruses were isolated from naturally infected cowpeas found in several districts of the Transvaal.

The standard test plants used were: *Phaseolus vulgaris* var. Canadian Wonder, *Vicia faba* and *Pisum sativum* var. Greenfeast; also *Nicotiana tabacum* var. White Burley, *N. glutinosa*, *Cucumis sativus*, and *Zinnia elegans* as so many cowpea viruses are related to the cucumber mosaic virus group. In addition, about 30 other legumes were included in the susceptibility tests.

Carborundum powder was used for the mechanical sap inoculations, and *Aphis craccivora* for the insect transmissions. (This aphis was used solely as a criterion of whether or not the viruses were indeed aphis transmissible.)

In this report three virus diseases found naturally on cowpea are described and compared with those already recorded in the literature.

During this survey of legume virus diseases, cowpea was found to be susceptible to many other legume virus when inoculated artificially. It also produced local necrotic lesions with the tomato spotted wilt virus.

1. Cowpea Mosaic Virus A.

Physical properties: Thermal inactivation point, 62–65°C. Longevity *in vitro*, 2–4 days. Dilution end point, 1: 2000.

Transmission: Mechanical sap inoculation. *Aphis craccivora.*

Host range: *Arachis hypogaea* L., *Crotalaria juncea* L., *C. spectabilis* Roth., *Dolichos lablab* L., *Glycine javanica* L., *G. max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L., vars. sweet and bitter, *L. luteus* L., *L. mutabilis* Sweet., *Medicago lupulina* L., *M. sativa* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus* L., *P. mungo* L., *P. vulgaris* L., *Pisum sativum* L., *Trifolium fragiferum* L., *T. hybridum* L., *T. incarnatum* L., *T. pratense* L., *T. repens* L., *Vicia faba* L., *Vigna sesquipedalis* (L.) Wight., *V. unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

Reaction of Susceptible Species.

Arachis hypogaea.

Local. No reaction.

Systemic. The leaves are crinkled, and chlorotic with dark green veinbands.

Crotalaria juncea.

Local. There are necrotic specks with chlorotic rings. The leaves drop.

Systemic. After a vein clearing and spotting in 10 days, the leaves develop a mottle with dark green blisters and veinbands. There are also necrotic specks. These leaves are crinkled and malformed with constrictions of the laminae. The plant is rosetted.

C. spectabilis.

Local. No reaction.

Systemic. After 13 days there is a vein clearing and chlorotic spotting and flecking of the young leaves. The next leaves develop irregular chlorotic areas with dark green veinbands and islands. These leaves are rolled, crinkled and slightly malformed.

Dolichos lablab.

Local. No reaction.

Systemic. There are diffuse chlorotic areas.

Glycina javanica.

Local. There are necrotic spots with chlorotic rings in 4 days.

Systemic. The leaves may have chlorotic areas or, if symptomless, the virus can be recovered.

G. max.

Local. Chlorotic spots may develop.

Systemic. There is a chlorotic spotting and vein flecking in 9 days. The next leaves develop a mottle with dark green blisters and irregular yellow areas. They are elongated and malformed with a crinkled surface. The older leaves have necrotic specks.

Lathyrus odoratus.

Local. No reaction.

Systemic. There are dark green veinbands on most leaves, which are also rolled. The plant is stunted.

Lupinus albus var. Sweet.

Local. There are dark green lesions on chlorotic leaves in 9 days and the leaves drop.

Systemic. At the same time the young leaves remain folded and have wavy margins, with a vein clearing and later spotting. The plant remains stunted. Necrotic specks develop later and the plant collapses.

L. albus var. Bitter.

Local. No reaction.

Systemic. The young leaves remain small and are chlorotic with dark green blisters. They are rosetted and have twisted tips. Necrosis sets in and many leaves drop.

L. luteus.

Local. Necrotic specks develop in 10 days.

Systemic. The young leaves remain folded and have twisted tips and chlorotic spots. Later leaves are mottled with dark green veinbands. They are small, rolled and malformed. Necrosis may set in and the leaves drop. The plant is stunted.

L. mutabilis.

Local. No reaction.

Systemic. The leaves are mottled with dark green blisters. The plant is rosetted and stunted.

Medicago lupulina.

A symptomless carrier.

M. sativa.

Local. No reaction.

Systemic. There is a chlorotic spotting with necrotic specks.

Melilotus officinalis.

A symptomless carrier.

Phaseolus acutifolius.

Local. There are chlorotic spots in 6 days.

Systemic. After a vein clearing of the young leaves in 9 to 10 days, most later leaves have a speck mottle.

P. lunatus.

Local. Large chlorotic blotches develop.

Systemic. The young leaves develop a vein clearing in 6 to 7 days (Fig. 1f). Later leaves have chlorotic vein flecks or irregular areas which become necrotic (Fig. 1e). These leaves may be crinkled.

P. mungo.

Local. There are necrotic spots, ringspots and veins in 7 days.

Systemic. In 3 weeks the young leaves may develop chlorotic specks which soon become necrotic.

P. vulgaris var. Canadian Wonder.

Local. In 4 days there are chlorotic spots which later have necrotic rings.

Systemic. The young leaves develop a vein clearing and chlorotic spotting in 6 days. Later leaves are mottled.

var. Haricot.

Local. In 4 days there are chlorotic spots which spread and fuse. There are also necrotic ringspots and veins.

Systemic. In 10 days the young leaves curl down and develop a vein clearing. These veins become necrotic and there are necrotic stem streaks. The plant is stunted and usually collapses.

Pisum sativum.

Local. No reaction.

Systemic. After a vein clearing and spotting there is a chlorotic mottle. The leaves may be slightly malformed and rosetted and the tendrils abnormally curled.

Trifolium fragiferum.

Local. There are necrotic rings on chlorotic leaves.

Systemic. No reaction.

T. hybridum.

Local. No reaction.

Systemic. Many leaves develop chlorotic streaks and spots.

T. incarnatum.

Local. The veins become necrotic and there are necrotic spots.

Systemic. The young leaves develop a vein clearing in 10 days, and later leaves have a chlorotic spotting, streaking, or mosaic with necrosis setting in, in the chlorosis. These leaves are crinkled, puckered and small. The plant is stunted and may later collapse.

T. pratense.

Local. No reaction.

Systemic. After a vein clearing of the young leaves in 18 to 19 days, later ones show a broad dark green midrib with chlorotic leaf margins. Some plants were symtomless carriers.

T. repens.

A symptomless carrier.

Vicia faba.

Local. There are necrotic ringspots on chlorotic leaves.

Systemic. In 3 weeks there is a chlorotic mottle.

Vigna sesquipedalis.

Local. There are chlorotic spots in 6 days.

Systemic. The young leaves show a vein clearing and spotting in 10 to 11 days. The next formed leaves are mottled with dark green veinbands and they are malformed. The old leaves become necrotic and drop.

V. unguiculata.

Local. There are necrotic spots in 5 days and there may be a slight veinal necrosis (Fig. 1a). The leaves show a marked epinasty and soon drop.

Systemic. The young leaves develop a vein clearing and flecking in 12 days. The next formed leaves have chlorotic spots and veinbands becoming a mosaic (Fig. 1b). Necrotic specks develop causing malformation and later these leaves drop (Fig. 1d). The plant is stunted and there are necrotic stem streaks (Fig. 1c).

Voandzeia subterranea.

Local. There are chlorotic spots in 6 days.

Systemic. After 13 days the young leaves develop a chlorotic network and spotting. Later leaves are mottled with dark green blisters and are contorted. The old leaves may develop a necrotic sheen.

Natural source of virus: *Vigna unguiculata.*

The plants were stunted. The younger leaves had chlorotic spots, dark green veinbands or a mosaic; and they were small and malformed. Older leaves showed varying amounts of necrosis in the chlorotic areas.

Identification.

According to Anderson (3b) in a classification of the known cowpea viruses, most are seed-borne. Exceptions are the mosaics described by d'Oliviera (11) and Dale (9) and the cucumber mosaic virus strains.

Cowpea mosaic viruses 2 and 3 d'Oliviera cause only systemic symptoms on cowpea, whereas this virus induces a marked local reaction as well. The thermal inactivation point is about 70°C but this virus withstood 62–65°C only.

d'Oliviera's cowpea mosaic virus 1 has a lower deathpoint (about 60°C) and causes both local and systemic symptoms on cowpea, but too few details are available for a complete comparison.

The cowpea mosaic of Dale is not transmissible by aphis, but by a leaf-beetle; and it withstands a much longer ageing period (20 days) and higher dilution (1: 100,000) than the virus described here.

In summing up the five groups of cowpea viruses, Anderson reports that none are able to infect *Medicago sativa*, *Trifolium incarnatum* or *Lathyrus odoratus*, all of which are susceptible to this virus. Further, the viruses of Yu (41), McLean (19) and Anderson (3b) are unable to infect the bean, and Snyder's (31) virus appears to be confined to *Vigna* spp.

The extremely high thermal inactivation points (98–104°C.) of Warid's *Vigna* viruses 1, 2, 3 and 3A and complexes 1, 2 and 3 exclude them from this comparison (35).

The virus described here is therefore considered to be a new entity belonging to the cowpea mosaic group, and is named cowpea mosaic virus A.

2. Cowpea Mosaic Virus B.

Physical properties: Thermal inactivation point, 60–62°C. Longevity *in vitro*, 2–3 days. Dilution end point, 1: 1000.

Transmission: Mechanical sap inoculation. Insect vector—probably an aphid but results were inconclusive.

Host range: *Crotalaria juncea* L., *C. spectabilis* Roth., *Dolichos lablab* L., *Glycine javanica* L., *G. max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L., vars. sweet and bitter, *L. luteus* L., *L. mutabilis* Sweet., *Medicago lupulina* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus* L., *P. mungo* L., *P. vulgaris* L., *Pisum sativum* L., *Trifolium incarnatum* L., *T. pratense* L., *Vicia faba* L., *Vigna sesquipedalis* (L.) Wight., *V. unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

Reaction of Susceptible Species.

Crotalaria juncea.

Local. No reaction.

Systemic. There are chlorotic spots on the young leaves which have wavy margins. The next leaves have a mottle with irregular chlorotic areas which result in malformation.

C. spectabilis.

Local. No reaction.

Systemic. After a vein clearing and spotting in 13 days, later leaves are rolled and have dark green veinbands.

Dolichos lablab.

Local. No reaction.

Systemic. There are scattered irregular chlorotic areas.

Glycine javanica.

Local. Necrotic lesions develop in 8 days.

Systemic. Some leaves have large chlorotic blotches on a puckered surface.

G. max.

Local. Chlorotic rings develop in 10 days and the leaves drop.

Systemic. There are chlorotic specks and irregular areas which cause a distortion of the leaf surface. The old leaves have necrotic specks.

Lathyrus odoratus.

Local. No reaction.

Systemic. The leaves curl down and have chlorotic spots and a dark green midrib.

Lupinus albus var. Sweet.

Local. No reaction.

Systemic. The leaves have wavy margins and a chlorotic network. Later ones develop a dark green veinbanding.

L. albus var. Bitter.

Local. No reaction.

Systemic. The leaves are small with twisted tips. They have a chlorotic mottle with a necrotic sheen. Many leaves drop and the plant is rosetted.

L. luteus.

Local. There are necrotic ringspots.

Systemic. Necrosis may spread rapidly into the growing point which curls to one side, before a total collapse of the plant. If not, the leaves remain folded, with wavy margins, and are mottled and small. The plant is stunted and rosetted.

L. mutabilis.

Local. No reaction.

Systemic. The leaves are malformed and stringlike and are chlorotic with dark green marginal blisters. The plant is rosetted.

Medicago lupulina.

A symptomless carrier.

Melilotus officinalis.

Local. No reaction.

Systemic. After a chlorotic spotting there is a dark green mottle.

Phaseolus acutifolius.

Local. In 10 days there are chlorotic spots with necrotic rings and veins.

Systemic. The plant collapses in 12 days after a severe necrosis.

P. lunatus.

Local. There are chlorotic spots in 10 days. These fuse to a general chlorosis.

Systemic. Diffuse vein flecks develop.

P. mungo.

Local. There are chlorotic spots in 7 days.

Systemic. The young leaves develop chlorotic then necrotic specks and veins in 11 days (Fig. 2c).

P. vulgaris var. Canadian Wonder.

Local. There are chlorotic spots in 4 days with a slight necrosis.

Systemic. The young leaves develop a vein clearing in 10 days and later ones have a mottle with dark green blisters.

var. Haricot.

Local. There are chlorotic and necrotic spots, and the leaves drop.

Systemic. Chlorotic spots develop on the young leaves. Later ones are mottled and reduced in size.

Pisum sativum.

Local. No reaction.

Systemic. The young leaves develop chlorotic spots and later ones a mottle. The tendrils are abnormally curled.

Trifolium incarnatum.

Local. There are chlorotic spots with necrotic rings and veins in 10 days.

Systemic. In 14 days there is a vein clearing followed by a veinbanding or mosaic on most leaves. They are crinkled and the plant is stunted.

T. pratense.

Local. No reaction.

Systemic. There are diffuse dark green veinbands.

Vicia faba.

Local. There are necrotic lesions in 10 days which fuse and the leaves drop.

Systemic. There is a chlorotic mottle.

Vigna sesquipedalis.

Local. Chlorotic spots develop in 10 days.

Systemic. The young leaves develop a vein clearing which may become necrotic. The next leaves are mottled and slightly malformed. (Fig. 2b.).

V. unguiculata.

Local. There are necrotic specks and a necrotic sheen in 3 days.

Systemic. The young leaves develop a vein clearing and chlorotic spotting while later ones are mottled with veinbands (Fig. 2d). There may be necrotic stem streaks. The plant is stunted (Fig. 2a).

Voandzeia subterranea.

Local. There is a necrotic sheen in 10 days.

Systemic. The young leaves develop a chlorotic spotting and veinbanding, and later leaves are malformed and have a mottle with necrotic specks.

Natural source of virus: *Vigna unguiculata.*

There was a mosaic or dark green veinbanding on the leaves, which were normal in size and shape. On the old leaves there was a slight necrosis in the chlorosis. The plants were not stunted or rosetted.

Identification.

Like cowpea mosaic virus A this virus cannot be identified with any of the described cowpea mosaics, nor with the cucumber mosaic strains. It further differs from cowpea mosaic virus A in host range, physical properties and symptoms on many hosts. See tables. Generally, the symptoms caused by the B virus are milder than those caused by the A virus.

This virus is therefore named cowpea mosaic virus B.

3. Cucumber Mosaic Virus Strain.

Physical properties: Thermal inactivation point, 62–64°C. Longevity *in vitro*, 4–5 days. Dilution end point, 1: 5000.

Transmission: Mechanical sap inoculation. *Aphis craccivora.*

Host range: *Arachis hypogaea* L., *Crotalaria juncea* L., *C. spectabilis* Roth., *Dolichos lablab* L., *Glycine max* (L.) Merr., *Lupinus albus* L., vars. sweet and bitter, *L. luteus* L., *L. mutabilis* Sweet., *Medicago lupulina* L., *M. sativa* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. mungo* L., *P. vulgaris* L., *Trifolium hybridum* L., *T. incarnatum* L., *T. medium* L., *T. pratense* L., *Vicia faba* L., *Vigna sesquipedalis* (L.) Wight., *V. unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

Cucumis sativus L., *Nicotiana glutinosa* L., *N. tabacum* L., *Solanum capsicum* L., *Zinnia elegans* Jacq.

Reaction of Susceptible Species.

Arachis hypogaea.

Local. No reaction.

Systemic. There is first a chlorotic spotting and then a mottle on later formed leaves.

Crotolaria juncea.

Local. No reaction.

Systemic. Most leaves develop a mottle with dark green islands. They are slightly malformed.

C. spectabilis.

Local. Necrotic lesions develop in 7 days.

Systemic. The young leaves show a chlorotic spotting and flecking. Later ones have chlorotic interveinal areas or a diffuse speck mottle.

Dolichos lablab.

Local. No reaction.

Systemic. In 3 weeks the older trifoliates show marked chlorotic line patterns and some chlorotic spotting. The young leaves are slightly ruffled and have irregular chlorotic blotches.

Glycine max.

Local. There may be a general chlorosis in 4 days.

Systemic. After 11 days there is a vein clearing of the young leaves. Later ones are mottled with dark green blisters and are severely malformed.

Lupinus albus var. Sweet.

Local. No reaction.

Systemic. The young leaves remain folded and have wavy margins. Later ones are mottled with dark green blisters and are malformed. The plant is rosetted.

var. Bitter.

Local. No reaction.

Systemic. The leaves become elongated and chlorotic with dark green areas. The plant may collapse.

L. luteus.

Local. No reaction.

Systemic. In 3 weeks the young leaves develop small chlorotic spots. Later leaves are very small and rosetted and the plant is very stunted.

L. mutabilis.

Local. No reaction.

Systemic. Most leaves are chlorotic with dark green marginal blisters. The plant is stunted and rosetted.

Medicago lupulina.

Local. No reaction.

Systemic. Most leaves develop diffuse chlorotic vein slashes.

M. sativa.

Local. There are small chlorotic spots.

Systemic. The young leaves show a vein clearing and later leaves may develop small dark green blisters. These are puckered and crinkled.

Melilotus officinalis.

Local. No reaction.

Systemic. In 3 weeks the young leaves show chlorotic streaks following the veins. On the old leaves there are occasional chlorotic ringspots.

Phaseolus acutifolius.

Local. No reaction.

Systemic. The young leaves show a vein clearing then a mottle with yellow specks.

P. mungo.

Local. No reaction.

Systemic. The first trifoliates show a spotting, and later formed leaves have a general chlorosis with slight necrosis. The necrosis may spread until the growing point collapses.

P. vulgaris var. Canadian Wonder.

Local. No reaction.

Systemic. In 13 days there is a mottle followed by vivid yellow spots and vein flecks on the second and third trifoliates (Fig. 3b). The young leaves may be symptomless and when subinoculated there is no virus present.

var. Haricot.

Local. No reaction.

Systemic. The young leaves develop chlorotic spots and then a mottle. Later leaves may be malformed and have yellow areas. The old leaves have large almost white chlorotic blotches.

Trifolium hybridum.

Local. No reaction.

Systemic. There are chlorotic streaks.

T. incarnatum.

Local. After 2 weeks dark green rings with chlorotic centres appear.

Systemic. The young leaves develop a chlorotic mosaic with necrotic specks and a slight crinkle.

T. medium.

Local. No reaction.

Systemic. In 3 weeks there are chlorotic streaks along the veins.

T. pratense.

Local. No reaction.

Systemic. There is first a vein clearing and later some veins become necrotic. This leads to a distortion of the leaves. The plant is stunted.

Vicia faba.

Local. There are necrotic rings in 6 days.

Systemic. In 11 days chlorotic spots develop on the young leaves and then necrotic specks. Later leaves are mottled with raised dark green areas and necrotic ring and line patterns. The petioles and stem may have superficial necrotic streaks.

Vigna sesquipedalis.

Local. In 7 to 8 days there are chlorotic spots with necrotic specks. These leaves drop.

Systemic. In 11 days the young leaves show a vein clearing, and later ones are vividly mottled, and rolled, curled and crinkled (Figs. 3d and f). The symptoms are similar to, but not as severe as, those on *V. unguiculata.*

V. unguiculata.

Local. In 4 to 5 days there are chlorotic spots which become necrotic. The leaves bend down and later drop.

Systemic. A week later chlorotic flecks develop on the older trifoliates which may be slightly puckered. Young leaves become progressively more crinkled and also malformed. They are a bright yellow and have dark green blisters and necrotic specks (Fig. 3e). These leaves are small and the plant is stunted and may collapse completely (Fig. 3a).

Voandzeia subterranea.

Local. No reaction.

Systemic. After 3 weeks the young leaves develop dark green blisters on a chlorotic background. Later leaves have vivid yellow spots and are curled and contorted.

Cucumis sativus.

Local. In 14 days small chlorotic spots develop (Fig. 2g).

Systemic. At the same time the young leaves show a clearing of the veins with dark green blisters. The plant remains stunted (Fig. 2g).

Nicotiana glutinosa.

Local. In 4 days necrotic lesions develop.

Systemic. Some leaves have chlorotic ring and line patterns which cause a distortion of the surface (Figs. 2e and f.)

N. tabacum.

Local. No reaction.

Systemic. Small chlorotic spots develop in 11 days and on later leaves there are chlorotic ring and line patterns, which distort the leaf surface.

Solanum capsicum.

Local. There are necrotic lesions in 4 days and the leaves drop.

Systemic. In 13 days there is a vein clearing followed by a mottle with necrotic specks which cause a malformation of the leaf.

Zinnia elegans.

Local. No reaction.

Systemic. After a vein clearing there is a mottle (Fig. 3c).

Natural source of virus: *Vigna unguiculata.*

The leaves had a vivid yellow mottle, and they were puckered and blistered. The plants were severely stunted.

Identification.

The very marked yellow mottle and severe stunt on cowpea can be compared with only one other virus. Smith & Barker (29) in their report on the bean yellows virus, mention the severe stunt and extreme chlorosis that virus causes on cowpea.

However, the symptoms on the bean are not similar, the host range is very limited and that virus is transmissible by *Empoasca fabalis.*

Apart from this characteristic yellow mottle on cowpea, there are similarities with several of the strains of cucumber mosaic virus, in respect of both physical properties and host range. The host range includes non-leguminous species.

On the cowpea there is some resemblance to the Y strain of Price (21), the yellow isolate of strain 14 of Whipple & Walker (38) and strain C of Fulton (14).

However, Price does not describe the symptoms on other legume hosts, so a comparison can not be made.

Both the Y isolate of strain 14 and strain C cause systemic necrosis and ultimate collapse of beans and peas, while this virus either induces a yellow fleck on beans or is latent; and it is unable to infect peas.

Whipple & Walker report that their strain 17, the celery virus 1 strain and the type cucumber mosaic virus all result in local lesions on cowpea, and systemic necrosis on pea. They are unable to infect beans. Peas are susceptible to all the other strains described by Fulton.

Harter's lima bean mosaic (16), also considered a strain of cucumber mosaic virus. causes only local lesions on cowpea, and is non-infectious to bean, lupin, soybean, alsike etc., all of which are hosts of this virus.

The strain of cucumber mosaic virus described by Anderson (3a), may cause both local and systemic symptoms on cowpeas, but on most varieties they are masked—in contrast to the severe effect of this virus. Furthermore the symptoms of Anderson's strain on tobacco and cucumber are transient only, whereas with this virus they are definite and lasting. Anderson's strain withstands only 6–24 hours ageing, and this one lasts 4–5 days.

To sum up—although this virus shows many links with the cucumber mosaic virus group, it can not be fully identified with any of the strains already described. It is therefore considered a new strain of the cucumber mosaic virus.

COMPARISON OF SYMPTOMS CAUSED BY COWPEA MOSAIC VIRUSES A AND B ON SOME HOST PLANTS.

Host Plant.	Cowpea Mosaic Virus A.	Cowpea Mosaic Virus B.
1. *Crotalaria juncea*.....	Local—necr. specks and chl. O. Syst.—mot., dgr. blisters and veinb., necr. specks.	Local—no reaction. Syst.—irreg. chl. areas, malformation.
2. *Lupinus albus*.....	Local—dark green spots. Syst.—chl. sp., necr. specks, collapse.	Local—no reaction. Syst.—chl. network, dgr. veinbands.
3. *Melilotus officinalis*.....	Symptomless carrier.	Local—no reaction. Syst.—dgr. mottle.
4. *Phaseolus acutifolius*....	Local—chl. spots. Syst.—speck mottle.	Local—chl. spots, necr. O and veins. Syst.—necrosis and collapse.
5. *Trifolium incarnatum*....	Local—necr. spots and veins. Syst.—chl. streaks, mosaic, necr., crinkle, ros., collapse.	Local—chl. spots, necr. O and veins. Syst.—mosaic, crinkle.
6. *Vigna sesquipedalis*.....	Local—chl. spots. Syst.—mot., dgr. veinbands, necrosis, malformation.	Local—chl. spots. Syst.—mottle.
7. *Vigna unguiculata*.....	Local—reflex., necr. sp. and veins. Syst.—mosaic, necr. specks, malformation, necr. stem streaks.	Local—necr. sheen. Syst.—mottle, dark green veinbands.

ABBREVIATIONS USED:—

chl.—chlorosis/chlorotic.
dgr.—dark green.
irreg.—irregular.
mot.—mottle.
necr.—necrosis/necrotic.
ros.—rosette.
sp.—spots.
veinb.—veinbands.
O—rings.

COMPARISON OF PHYSICAL PROPERTIES AND METHODS OF TRANSMISSION.

Virus.	Thermal inactivation point.	Longevity *in vitro*.	Dilution end point.	Transmission.		
				Sap.	Seed.	Aphid.
Cowpea mosaic virus A.....	62–65°C	2–4 days	1 : 2000	+	—	+
Cowpea mosaic virus B.....	60–62°C	2–3 days	1 : 1000	+	—	?
Cucumber mosaic virus strain	62–64°C	4–5 days	1 : 5000	+	—	+

HOST RANGES.

	Cowpea Mosaic Virus A.	Cowpea Mosaic Virus B.	Cucumber Mosaic Virus Strain.
Arachis hypogaea	+	−	+
Crotalaria juncea	+	+	+
C. spectabilis	+	+	+
Dolichos lablab	+	+	+
Glycine javanica	+	+	
G. max	+	+	+
Lathyrus odoratus	+	+	−
Lupinus albus—sweet	+	+	+
Lupinus albus—bitter	+	+	+
L. luteus	+	+	+
L. mutabilis	+	+	+
Medicago lupulina	+	+	+
M. sativa	+	−	+
Melilotus officinalis	+	+	+
Phaseolus acutifolius	+	+	+
P. lunatus	+	+	
P. mungo	+	−	+
P. vulgaris	+	+	+
Pisum sativum	+	+	−
Trifolium fragiferum	+	−	−
T. hybridum	+	−	+
T. incarnatum	+	+	+
T. pratense	+	+	−
T. repens	+	−	
Vicia faba	+	+	
Vigna sesquipedalis	+	+	+
V. unguiculata	+	+	
Voandzeia subterranea	+	+	+
Cucumis sativus	−	−	+
Nicotiana glutinosa	−	−	+
N. tabacum	−	−	+
Solanum capsicum	−	−	+
Zinnia elegans	−	−	+

SUMMARY.

Three virus diseases of naturally infected cowpeas are described in detail—their physical properties, methods of transmission, host ranges and symptoms. None could be fully identified with any previously recorded virus or strain.

1. Cowpea mosaic virus A. In the field the plants are stunted and the leaves are small and malformed. They have dark green veinbands or a mosaic with necrosis. The virus is inactivated at temperatures of 62–65°C., at a dilution of 1:2,000 and after 2–4 days ageing *in vitro*. It is sap and aphid transmissible and the host range is confined to the *Leguminosae*.

2. Cowpea mosaic virus B. The only symptom in the field is a dark green veinbanding. The thermal inactivation point of the virus is 60–62°C. The longevity *in vitro* is 2–3 days and the dilution end point, 1: 1,000. It is sap transmissible, but results from insect transmissions were inconclusive. The host range is confined to the legumes, and the symptoms are generally milder than for the A virus.

3. Cucumber mosaic virus strain. The field symptoms are severe—the plants are very stunted and the leaves show a vivid yellow mottle. Similarities in physical properties, host range (which includes the non-legumes) and symptoms, indicate a relationship with the cucumber mosaic virus group.

LITERATURE CITED.

1. Ainsworth, G. C. (1935)..... Mosaic diseases of the cucumber. Ann. Appl. Biol., 22: 55–67.
2. Ainsworth, G. C. (1940)..... The identification of certain viruses found infecting leguminous plants in Great Britain. Ann. Appl. Biol., 27: 218–226.
3. Anderson, C. W. (1955)..... *Crotalaria* and *Vigna* viruses in Florida.
   (*a*) I. Preliminary report on a strain of cucumber mosaic virus obtained from cowpea plants. Plant Dis. Reptr., 39: 346–348.
   (*b*) II. Notations concerning cowpea mosaic virus (*Marmor vignae*). Plant Dis. Reptr., 39: 349–353.
   (*c*) III. Notations concerning identification difficulties, indicator plants, possible vector relationships and virus maintenance. Plant Dis. Reptr., 39: 354–357.
4. Black, L. M. and Price, W. C. (1940) The relationship between viruses of potato calico and alfalfa mosaic. Phytopathology, 30: 444–447.
5. Briant, A. K., and Martyn, E. B. (1929) Diseases of cover crops. Trop. Agric., 6: 258–260.
6. Capoor, S. P., Varma, P. M. and Uppal, B. N. (1947) A mosaic disease of *Vigna catjang* Walp. Curr. Sci., 16: 151–
7. Capoor, S. P. (1956)..... Mosaic of *Vigna cylindrica*. Ind. Jour. Agric. Sci., 26: 95–
8. Dale, W. T. (1943)..... Preliminary studies of the plant viruses of Trinidad. Trop. Agric., 20: 228–235.
9. Dale, W. T. (1949)..... Observations on a virus disease of cowpea in Trinidad. Ann. Appl. Biol., 36: 327–333.
10. Dale, W. T. (1953)..... The transmission of plant viruses by biting insects, with particular reference to cowpea mosaic. Ann. Appl. Biol., 40: 384–392.
11. d'Oliviera, M. A. (1947)..... Contribuicao ao estudo dos virus causadores de mosaico nos feijoes macassar. (*Vigna spp.*) Bol. Tecn. Agron. Sul. (Pelotas), 1: 1–36.
12. Elliott, J. A. (1921)..... A mosaic of sweet and red clovers. Phytopathology, 11: 146–148.
13. Elmer, O. H. (1925)..... Transmissibility and pathological effects of the mosaic disease. Iowa A.E.S. Bull., 82: 39–91.
14. Fulton, J. P. (1950)..... Studies on strains of cucumber virus 1 from spinach. Phytopathology, 40: 729–736.
15. Hagedorn, D. J. (1950)..... A cucumber strain with a wide leguminous host range. Phytopathology (abstract), 40: 11.
16. Harter, L. L. (1938)..... Mosaic of lima beans. (*Phaseolus lunatus macrocarpus*). Journ. Agric. Res. (U.S.), 56: 895–906.
17. Johnson, F. (1942)..... The complex nature of white clover mosaic. Phytopathology, 32: 103–116.
18. McClintock, J. A. (1917)..... Lima bean mosaic. Phytopathology, 7: 60–61.
19. McLean, D. M. (1941)..... Studies on mosaic of cowpeas, *Vigna sinensis*. Phytopathology, 31: 420–430.
20. Pierce, W. H. (1934)..... Viroses of the bean. Phythopathology, 24: 87–115.
21. Price, W. C. (1934)..... Isolation and study of some yellow strains of cucumber mosaic virus. Phytopathology, 24: 743–761.
22. Price, W. C. (1935)..... Acquired immunity from cucumber mosaic in zinnia. Phytopathology, 25: 776–789.
23. Reddick, D. and Steward, V. B. (1918) Varieties of beans susceptible to mosaic. Phytopathology, 8: 530–531.
24. Severin, H. H. P. and Henderson, C. F. (1928) Some host plants of curly top. Hilgardia, 3: 339–392, 595–636.
25. Sinclair, J. B. and Walker, J. C. (1955) Inheritance of resistance to cucumber mosaic virus in cowpea. Phytopathology, 45: 563–564.

26. (*a*) Sill, W. H. Jr. and Walker, J. C. (1952) — Cowpea as an assay host for cucumber virus 1. Phytopathology, 42: 328–330.

26. (*b*) Sill, W. H. Jr. and Walker, J. C. (1952) — A strain of cowpea susceptible to systemic infection by various strains of common cucumber mosaic virus. Phytopathology, 42: 442.

27. Smith, C. E. (1924)..... — Transmission of cowpea mosaic by the bean leafbeetle. Science, 60: 268.

28. Smith, K. M. (1935)..... — A new virus disease of the tomato. Ann. Appl. Biol., 22: 731–741.

29. Smith, R. C. and Barker H. D. (1930) — Observations on the " yellows " disease of beans and related plants in Haiti. Jour. Econ. Ento., 23: 842–847.

30. Smith, K. M. and Bald, J. C. (1935) — A necrotic virus disease affecting tobacco and other plants. Parasitology, 27: 231–245.

31. Snyder, W. C. (1942)..... — A seed-borne mosaic of asparagus bean, *Vigna sesquipedalis*. Phytopathology, 32: 518–523.

32. Vasuveda, R. S. (1942)..... — A mosaic disease of cowpea. Ind. Jour. Agric. Sci., 12: 281–283.

33. Walker, J. C., Whipple, O. C. and Virgin, W. (1937) — Plant diseases. Rept. Wisc. Agric. Exp. Sta. 1935–36. Bull. 438.

34. Warid, W. A. and Plakidas, A. G. (1950) — New viruses naturally infectious to cowpea. Phytopathology, 40: 30–31.

35. Warid, W. A. and Plakidas, A. G. (1952) — Thermophilic viruses naturally infectious to cowpea. Plant Dis. Reptr., 36: 380–381.

36. Weiss, F. (1945)..... — Viruses described primarily on leguminous vegetable and forage crops. Plant Dis. Reptr., Suppl. 154: 32–80.

37. Wellman, F. L. (1934)..... — Identification of Celery Virus 1, the cause of southern celery mosaic. Phytopathology, 24: 695–725.

38. Whipple, O. C. and Walker, J. C. (1941) — Strains of cucumber mosaic virus pathogenic on bean and pea. Jour. Agric. Res., 62: 27–60.

39. Wingard, S. A. (1928)..... — Host and symptoms of ringspot, a virus disease of plants. Jour. Agric. Res. 37: 127–153.

40. Yu, T. F. (1939)..... — A list of plant viruses observed in China. Phytopathology, 29: 459–460.

41. Yu, T. F. (1946)..... — A mosaic disease of cowpea. (*Vigna sinensis* Endl.). Ann. Appl. Biol., 33: 450–454.

42. Yu, T. F. (1947)..... — Spotted wilt of broad bean. Phytopathology (Notes), 37–191.

43. Zaumeyer, W. J. (1938)..... — A streak disease of peas and its relation to several strains of alfalfa mosaic virus. Jour. Agric. Res., 56: 747–772.

44. Zaumeyer, W. J. (1939)..... — Two new viruses affecting pea. Phytopathology (Abstract), 29: 25.

45. Zaumeyer, W. J. and Wade, B. L. (1935) — The relationship of certain legume mosaics to bean. Jour. Agric. Res., 51: 715–749.

FIG. 1.—COWPEA MOSAIC VIRUS A.

A–D *Vigna unguiculata*. A. Local necrotic lesions. B. Systemic veinbanding and mosaic. C. Systemic necrotic specks. D. Malformation of young leaves.

E–F *Phaseolus lunatus*. E. Necrosis and chlorosis on older leaf. F. Fine chlorotic network on young leaf.

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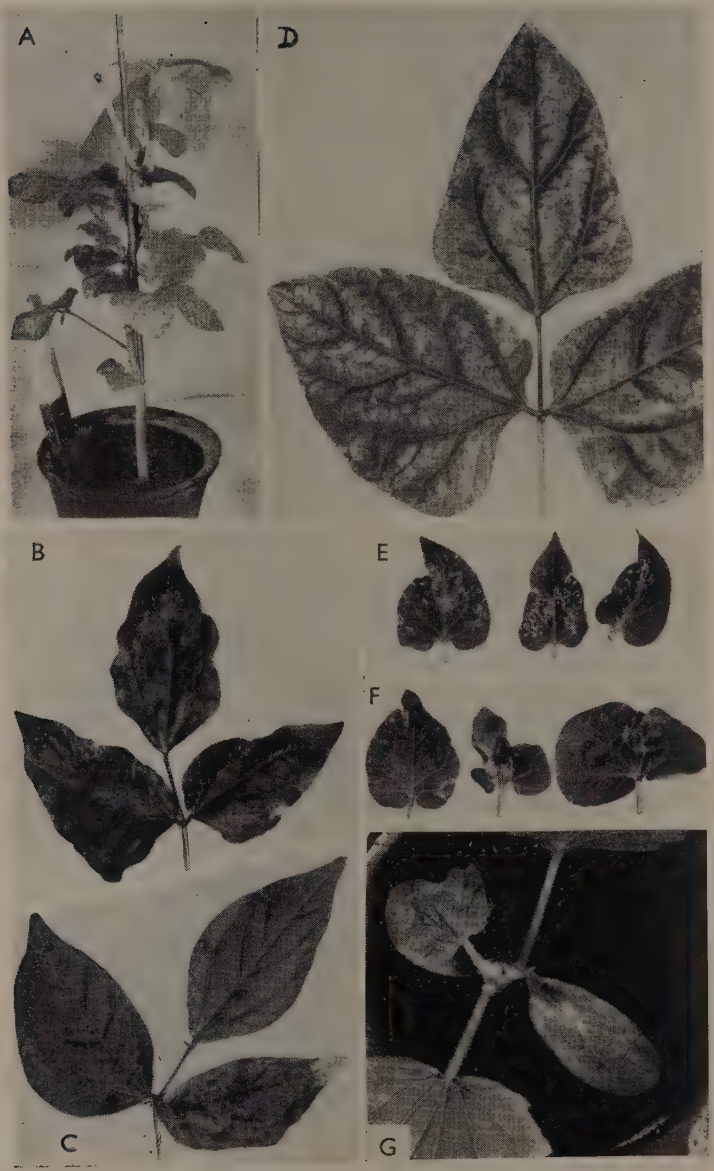

FIG. 2.—A–D COWPEA MOSAIC VIRUS B.
A and D *Vigna unguiculata*. B. *V. sesquipedalis*. C. *Phaseolus mungo*.
E–G CUCUMBER MOSAIC VIRUS STRAIN.
E and F *Nicotiana glutinosa*. G. *Cucumis sativus*.

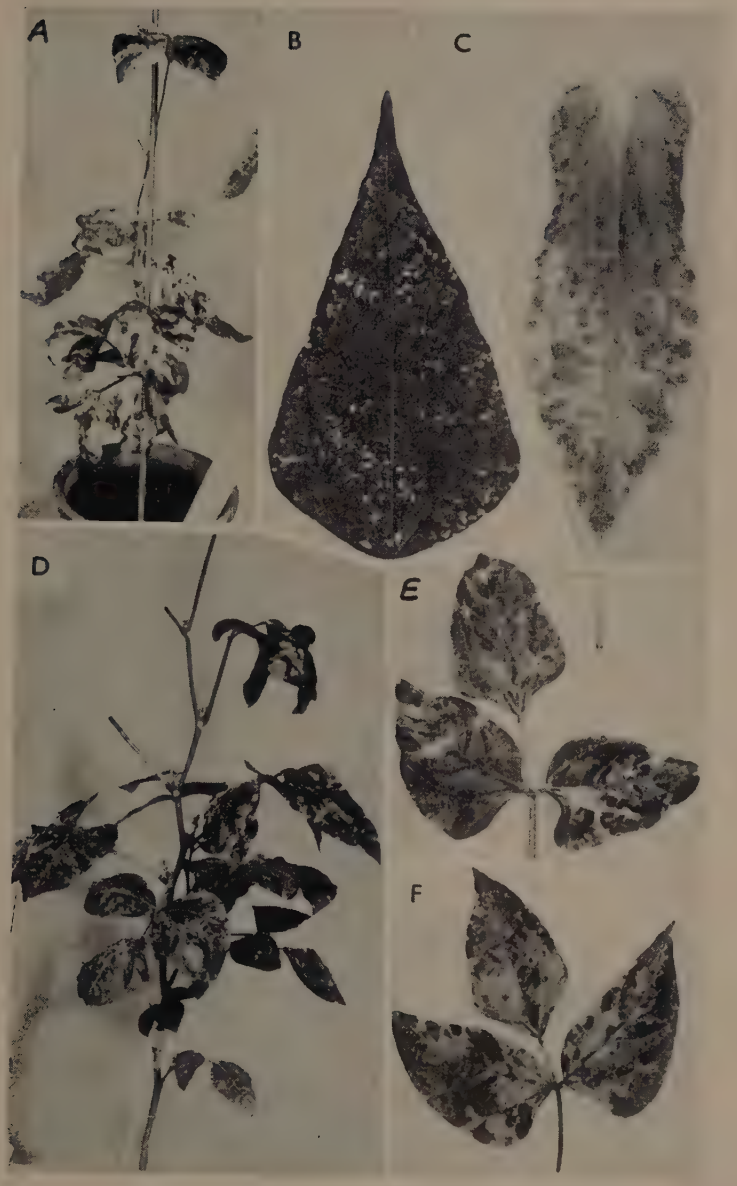

FIG. 3.—CUCUMBER MOSAIC VIRUS STRAIN.

A and E. *Vigna unguiculata.* D. and F. *V. sesquipedalis.* B. *Phaseolus vulgaris.* C. *Zinnia elegans.*

Virus Diseases of Peas and Sweet Peas.

By

Patricia J. Klesser.

According to the Revised List of Plant Diseases occuring in South Africa (3), the only virus disease of peas and sweet peas that has been positively identified, is the one caused by the tomato spotted wilt virus.

Other disorders due to virus infections have long been recognised but the causal organisms were not determined.

This report concerns eight viruses which occur naturally on *Pisum sativum* and *Lathyrus odoratus* in South Africa.

Apart from tomato spotted wilt there are three other diseases which are commonly found on both peas and sweet peas, viz. pea mosaic, pea stunt and a strain of lucerne mosaic.

Further, peas are naturally infected by pea virus 2, pea mosaic virus 4, and a strain of pea wilt virus. Sweet peas are also susceptible in the field to bean local chlorosis virus B and a strain of bean yellow mosaic.

Although pea mosaic, pea virus 2 and pea stunt are well-known elsewhere, they are reported for the first time in South Africa. (Pea mosaic virus 4 was discussed in detail in the paper on lupin virus diseases, as it occurs frequently on *Lupinus* species.)

Details of what appear to be new strains of the pea wilt, lucerne mosaic and bean yellow mosaic viruses are given, and a virus causing vivid local chlorotic spots on bean is described.

Pea mosaic has long been recognised as the primary virus disease of peas, but in this country more damage is caused by the tomato spotted wilt virus. This occurs frequently, and results in a systemic necrosis and possible collapse of the plants.

The other viruses are found spasmodically but the effect on individual plants can be severe. The necrotic ring strain of the lucerne mosaic virus also induces a systemic necrosis and collapse of the plant, while the pea stunt and pea wilt viruses cause necrotic stem streaks with a mosaic.

With the pea mosaic virus and pea virus 2 there is only a mosaic or mottle.

On the sweet pea, chlorotic spots, veinbands or a mosaic, may develop on the leaves of plants infected with the pea mosaic virus, or strains of the bean yellow mosaic and bean local chlorosis viruses.

Systemic necrosis occurs when the spotted wilt virus, pea stunt virus or a strain of lucerne mosaic virus are present.

Most of these viruses can cause a colour break on the flowers.

METHODS AND MATERIALS.

The standard test plants used were: *Phaseolus vulgaris* var. Canadian Wonder, *Vicia faba* var. Aquadulce and *Pisum sativum* var. Greenfeast. In addition about 30 other legumes and some plants belonging to the *Solanaceae* were used in susceptibility tests.

Aphis craccivora or *Macrosiphum pisi* were used for the insect transmission tests, although they are not necessarily the natural vectors. Carborundum powder was used for the sap inoculations.

In this report eight virus diseases are described—their physical properties, methods of transmission, host ranges and symptoms on susceptible hosts.

Their identification is based on information from the literature, but when no complete correlation can be found, new names are provisionally proposed.

1. **Pea Mosaic Virus** Doolittle & Jones.

Physical properties: Thermal inactivation point, 56–58°C. Longevity *in vitro*, 2–3 days. Dilution end point, 1: 1,000–1: 2,000.

Transmission: Mechanical sap inoculation. *Aphis craccivora.*

Host range: *Crotalaria juncea* L., *Glycine javanica* L., *Lathyrus odoratus* L., *Lens esculentum* L., *Lupinus albus* L., *L. luteus* L., *Medicago lupulina* L., *Melilotus officinalis* Willd., *Phaseolus mungo* L., *P. vulgaris* L., (?) *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *T. pratense* L., *T. repens* L., *Vicia faba* L.

Reaction of Susceptible Species.

Crotalaria juncea.

Local. Necrotic rings can be seen after 6 days. These fuse and the leaf drops

Systemic. The young leaves develop chlorotic spots with necrotic centres. This necrosis spreads until the leaf is " scorched " and eventually drops. Due to streak necrosis, the stem curves at the top, and the plant soon dies.

Glycine javanica.

A symptomless carrier.

Lathyrus odoratus.

Local. No reaction.

Systemic. The leaves develop chlorotic spots and later a mosaic. They are rolled and reduced in size. The flowers have a marked colour break (Fig. 1c).

Lens esculentum.

Local. No reaction.

Systemic. In about 11 days the young leaves show chlorotic spots or streaks. Later necrosis may set in, in these areas and the plant collapses. If necrosis is not present the leaves are tightly curled and the stems are rosetted, with a general stunt of the plant.

Lupinus albus.

Local. In 6 days there are small chlorotic spots with necrotic centres.

Systemic. In 14 days the veins of the young leaves become necrotic and the leaflets drop. Later formed leaves are firstly chlorotic but soon become necrotic. The growing point is stunted and almost completely defoliated. The stem becomes necrotic and the plant collapses. The stem necrosis occurs in streaks on one side only, resulting in a curved stem (Fig. 1d).

L. luteus.

Local. No reaction.

Systemic. The young leaves remain folded and have wavy margins. They are mottled. The plant is stunted and no flowers are formed.

Medicago lupulina.

A symptomless carrier.

Melilotus officinalis.

Local. No reaction.

Systemic. Chlorotic vein slashes develop in one month.

Phaseolus mungo.

Local. The veins become necrotic and the leaves collapse.

Systemic. The young leaves curl down and their veins become necrotic, with the interveinal areas quite chlorotic. A stem necrosis may develop and the plant then collapses.

P. vulgaris var. Canadian Wonder.

Local. No reaction.

Systemic. Occasionally the first trifoliates develop large chlorotic blotches. The young leaves may have a chlorotic network.

var. Haricot.

Local. No reaction.

Systemic. The leaves may be mottled with a slight malformation.

Pisum sativum.

Local. No reaction.

Systemic. In 7 days there is a clearing of the veins of the young leaves with small chlorotic flecks. A week later this is followed by a mosaic mottle of the youngest leaves, (Fig. 1a) but there may also be dark green veinbands or irregular chlorotic slashes. The leaves remain slightly folded, and are puckered and reduced in size. The growing point is rosetted and the tendrils abnormally curled.

Trifolium hybridum.

Local. No reaction.

Systemic. After a vein clearing the leaves show a chlorotic streaking.

T. incarnatum.

Local. No reaction.

Systemic. The young leaves develop a clearing of the veins in 7 days. Later formed leaves may show a chlorotic spot mottling, veinbanding or a characteristic chlorotic triangle at the apex. These leaves are crinkled and rolled and the plant is stunted (Fig. 1b).

T. pratense.

A symptomless carrier.

T. repens.

A symptomless carrier.

Vicia faba.

Local. No reaction.

Systemic. After 7 days a diffuse mottle develops on the young leaves. A week later the young leaves show a mosaic, and they are rolled and reduced in size.

Natural source of virus: *Pisum sativum* (Pretoria and district). The older leaves were flecked and mottled and the younger ones had a mosaic mottle. The plants were rosetted and the tendrils were abnormally curled.

Lathyrus odoratus (Pretoria). The leaves had a chlorotic streak mottle and there was a marked colour break on the flowers.

Identification.

From the symptom expression, host range and physical properties, there can be little doubt that this is the pea mosaic virus.

2. **Pea Virus 2** Osborn.

Physical properties: Thermal inactivation point, 60–62°C. Longevity *in vitro*, 3–4 days. Dilution end point, 1: 2,000.

Transmission: Mechanical sap inoculation. *Macrosiphum pisi.*

Host range: *Lathyrus odoratus* L., *Lupinus albus* L., *Medicago lupulina* L., *Phaseolus vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. pratense* L., *Vica faba* L.

Reaction of Susceptible Species.

Lathyrus odoratus.

Local. No reaction.

Systemic. In 14 days the leaves show a mosaic mottle with chlorotic streaks. These leaves are slightly curled downwards.

Lupinus albus.

Local. In 9 days there are large necrotic lesions which fuse, and the leaflets drop.

Systemic. 3 to 4 days later the necrosis extends up the stem and into the growing point, and the plant collapses (Fig. 2d).

Medicago lupulina.

Local. No reaction.

Systemic. Only a fine chlorotic network of the younger leaves develops.

Phaseolus vulgaris var. Canadian Wonder.

Local. No reaction.

Systemic. In a week chlorotic spots appear on the young leaves. The second and third trifoliates develop chlorotic flecks, and later formed leaves show only irregular chlorotic areas. These leaves have slightly uneven surfaces (Fig. 2b). The plant is stunted and rosetted, with pods blistered in dark green.

Pisum sativum.

Local. The inoculated leaves wither and drop.

Systemic. In a week the young leaves develop a vein clearing and chlorotic spotting. Later leaves show a mosaic with dark green veinbands and they are curled upwards. The plant is rosetted and stunted, and the tendrils are abnormally curled (Fig. 2a).

Trifolium hybridum.

Local. No reaction.

Systemic. There are alternate chlorotic and green streaks following the veins of the leaves.

T. pratense.

Local. No reaction.

Systemic. Diffuse chlorotic vein slashes develop in one month.

Vicia faba.

Local. No reaction.

Systemic. In 7 days there is a clearing of the veins of the young leaves followed by a chlorotic spotting. Later leaves have a mosaic in which the dark green areas are raised (Fig. 2c.) There may also be concentric chlorotic patterns on these leaves.

Natural source of virus: *Pisum sativum* (Pretoria and district). The plants were rosetted and the leaves showed a chlorotic flecking and mosaic mottle.

Identification.

This virus is similar to the pea mosaic virus of Doolittle & Jones (4) in many respects, but it regularly causes a systemic reaction on the bean.

The pea virus 2 Osborn (10), shows this ability to infect certain varieties of bean; and therefore this virus appears to be identical with or closely related to it.

3. **Pea Stunt Virus** Zaumeyer.

Physical properties: Thermal inactivation point, 60–62°C. Longevity *in vitro*, 2–3 days. Dilution end point, 1: 5,000–1: 10,000.

Transmission: Mechanical sap inoculation.

Host range: *Crotalaria juncea* L., *C. spectabilis* Roth., *Glycine max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L., *L. luteus* L., *Medicago sativa* L., *Phaseolus vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *Vicia faba* L., *Vigna sesquipedalis* (L.) Wight., *V. unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

Reaction of Susceptible Species.

Crotalaria juncea.

Local. Some necrosis may occur.

Systemic. After 17 days there are dark green veinbands and a speck mottle. The leaves are small, rolled and rosetted, and the plant is stunted.

C. spectabilis.

Local. No reaction.

Systemic. The young leaves show chlorotic veins and spots in 7 days. Later leaves are malformed and crinkled, with irregular chlorosis. The plant is stunted.

Glycine max.

Local. The leaves become chlorotic and drop.

Systemic. After a chlorotic spotting the leaves develop a mottle with some yellow specks. The old leaves have a chlorotic network.

Lathyrus odoratus.

Local. No reaction.

Systemic. After 2 weeks many leaves show dark green veinbands or a mottle. They are rolled and slightly puckered.

Lupinus albus.

Local. There are necrotic specks with chlorotic halos.

Systemic. The young leaves have necrotic specks and veins, and soon drop. The next leaves are chlorotic with dark green blisters, and they are rolled and crinkled. There are necrotic stem streaks and the plant is stunted.

L. luteus.

Local. No reaction.

Systemic. The young leaves remain folded and in 9 days there is a vein clearing. Later ones are mottled, elongated and crinkled with wavy margins. The plant is stunted and rosetted.

Medicago sativa.

Local. No reaction.

Systemic. There is a chlorotic network followed by a chlorotic flecking on some leaves.

Phaseolus vulgaris var. Canadian Wonder.

Local. No reaction.

Systemic. In 6 to 8 days the young leaves show a vein clearing while the first and second trifoliates develop chlorotic blotches, spots, or vein flecks. Later leaves are mottled and rolled with a slight puckering (Fig. 3b). The pods are blistered (Fig. 3c) and the plant is stunted.

var. Haricot.

Local. No reaction.

Systemic. The young leaves may drop after a veinal necrosis. The next formed leaves are small and malformed with a chlorotic mottle.

Pisum sativum.

Local. No reaction.

Systemic. The young leaves develop chlorotic veins in 6 days, and then spots. Later leaves have a mosaic, and they are malformed and reduced in size. The tendrils are abnormally curled (Fig. 3a). Later leaves have necrosis in the chlorosis and there are necrotic stem streaks. The pods have purple lesions.

Trifolium hybridum.

Local. No reaction.

Systemic. After 16 days the leaves show chlorotic veins, spots and streaks, and they may be slightly crinkled.

T. incarnatum.

Local. No reaction.

Systemic. There is a chlorotic network on the young leaves. Later ones have dark green veinbands or a mosaic, and they are crinkled. The old leaves may have necrotic specks.

Vicia faba.

Local. No reaction.

Systemic. After 7 days there are chlorotic spots on the young leaves. Later leaves have dark green veinbands or a mosaic; they are long and narrow and rolled (Fig. 3d).

Vigna sesquipedalis.

A symptomless carrier.

V. unguiculata.

A symptomless carrier.

Voandzeia subterranea.

A symptomless carrier.

Natural source of virus: *Lathyrus odoratus* (Pretoria and district). Most leaves had a chlorotic mottle, and there were necrotic stem streaks. The flowers showed a marked colour break. *Pisum sativum* (Pretoria and district). The leaves had irregular chlorotic areas with varying amounts of necrosis. There were also necrotic stem streaks and the plants were stunted.

Identification.

This virus shows most similarity with the stunt virus of Zaumeyer (17), both in respect of symptomology and physical properties. Although not identical, it is considered closely related to the pea stunt virus.

4. **Pea Wilt Virus**—New Strain.

Physical properties: Thermal inactivation point, 58–60 °C. Longevity *in vitro*, 2–3 days. Dilution end point; 1: 10,000.

Transmission: Mechanical sap inoculation. *Aphis craccivora.*

Host range: *Arachis hypogaea* L., *Crotalaria juncea* L., *C. spectabilis* Roth., *Dolichos lablab* L., *Glycine javanica* L., *G. max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L., *L. luteus* L., *Medicago lupulina* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus* L., *P. mungo* L., *P. vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *T. pratense* L., *Vicia faba* L., *Vigna sesquipedalis* (L.) Wight., *V. unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

Reaction of Susceptible Species.

Arachis hypogaea.

Local. No reaction.

Systemic. Some leaves have a chlorotic mottle with patterns and the older ones have chlorotic blotches.

Crotalaria juncea.

Local. No reaction.

Systemic. In 15 days the growing point becomes stunted and may bend over. The leaves are uniformly chlorotic with only isolated dark green areas. Later formed leaves are chlorotic with dark green blisters and veinbands. They have crinkled surfaces and are slightly malformed. The plant is stunted.

C. spectabilis.

Local. There are necrotic lesions in 7 days.

Systemic. After a chlorotic vein flecking of the young leaves, later ones are chlorotic with dark green specks. These leaves are crinkled and the plant is stunted.

Dolichos lablab.

A symptomless carrier.

Glycine javanica.

A symptomless carrier.

G. max.

Local. There are chlorotic spots which later have a necrotic ring. There is also some veinal necrosis.

Systemic. In 9 days the young leaves show a clearing of the veins. This becomes a dark green mottle on the next formed leaves, which are also puckered. The older leaves may have small necrotic spots.

Lathyrus odoratus.

Local. No reaction.

Systemic. The leaves remain folded and they are chlorotic with dark green islands, and slightly malformed. Some plants collapsed from necrosis.

Lupinus albus.

Local. Small chlorotic spots appear in 9 days and the leaflets drop later.

Systemic. The young leaves have a chlorotic network and the leaflets remain folded and have wavy margins. There may be stem necrosis. There is little upward growth so that the growing point becomes stunted and rosetted with many small stringlike leaves. These are chlorotic with dark green marginal blisters. No flowers are formed.

L. luteus.

Local. No reaction.

Systemic. In 13 days the young leaves show chlorotic spots and they remain folded. Later leaves are mottled or have dark green blisters on malformed, stringlike leaves. The plant is stunted and rosetted.

Medicago lupulina.

Local. No reaction.

Systemic. A diffuse chlorotic mottle develops.

Melilotus officinalis.

Local. No reaction.

Systemic. After a vein clearing of the young leaves, there are chlorotic spots or streaks on later formed leaves.

Phaseolus acutifolius.

Local. In 4 days the veins are necrotic and later chlorotic spots develop.

Systemic. After 10 to 11 days, the young leaves show a vein clearing and later a mottle. There may be some malformation. New leaves have almost yellow specks.

P. lunatus.

Local. Chlorotic veins and irregular areas develop in 7 to 9 days.

Systemic. In 9 days there is a vein clearing of the young leaves. Later ones have a diffuse mottle, veinbanding or flecking.

P. mungo.

Local. No reaction.

Systemic. There is a diffuse chlorotic speckling after 2 weeks. On the old leaves there is also necrosis.

P. vulgaris var. Canadian Wonder.

Local. No reaction.

Systemic. After 9 days the first trifoliates show large chlorotic star flecks. The young leaves have a vein clearing and later ones a spot mottle with the dark green along the veins (Fig. 4d).

var. Haricot.

Local. The veins are slightly necrotic and later small chlorotic spots with necrotic halos appear.

Systemic. There is a chlorosis with dark green blisters, and malformation and twisting of the leaves. There is only a slight necrosis.

Pisum sativum.

Local. The inoculated leaves collapse.

Systemic. There is a vein clearing in 2 weeks, followed by a chlorotic mottling of the leaves which remain slightly folded. The plant is rosetted and stunted (Fig. 4a). The stem may have necrotic streaks and the tendrils are abnormally curled.

Trifolium hybridum.

Local. No reaction.

Systemic. In 24 days there is a clearing of the veins of the young leaves, and thereafter, alternate streaks of yellow and green develop on later formed leaves.

T. incarnatum.

Local. There are necrotic specks in 7 to 8 days.

Systemic. The young leaves develop a vein clearing. Later ones have dark green veinbands and they are puckered and crinkled.

T. pratense.

Local. No reaction.

Systemic. There are occasional chlorotic vein streaks which become necrotic and result in a malformation of the leaf surface (Fig. 4c).

Vicia faba.

Local. The leaves develop dark green or necrotic rings. They become flaccid and drop (Fig. 4b).

Systemic. No reaction, but the virus is present.

Vigna sesquipedalis.

Local. Within a week chlorotic spots appear.

Systemic. In 21 days the young leaves show chlorotic spots, and later ones a mottle and malformation.

V. unguiculata.

Local. There are necrotic specks with chlorotic halos.

Systemic. In 2 weeks there is a vein clearing followed by a diffuse chlorotic mottle.

Voandzeia subterranea.

Local. No reaction.

Systemic. There are chlorotic specks and dark green veinbands.

Natural source of virus: *Pisum sativum* (Pretoria). The plants were stunted and unthrifty and the leaves had a very diffuse mottle. *Phaseolus vulgaris* (Pretoria and district). On the variety Black Wonder the younger leaves had vivid chlorotic spots and the older ones a dark green veinbanding and mottle. The plants were stunted.

Identification.

On the major host plants e.g. pea, cowpea, bean and broad bean, the symptoms produced by this virus are very similar to those caused by the pea wilt virus Johnson (8). But on other plants there are small differences and the physical properties differ in the longevity and dilution end points.

Nevertheless, this virus is grouped with it as a possible strain, and is named pea wilt virus, strain A.

5. Lucerne Mosaic Virus—Necrotic Ring Strain.

Physical properties: Thermal inactivation point, 62–65°C. Longevity *in vitro*, 7–8 days. Dilution end point, 1: 3,000–1: 5,000.

Transmission: Mechanical sap inoculation. *Aphis craccivora.*

Host range: *Crotalaria juncea* L., *C. spectabilis* Roth., *Glycine max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L., *L. luteus* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *Vicia faba* L., *Vigna unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

Reaction of Susceptible Species.

Crotalaria juncea.

Local. In 6 days there are necrotic lesions.

Systemic. The young leaves show chlorotic spots which soon become necrotic and cause a malformation of the leaves. The plant is stunted.

C. spectabilis.

Local. There are dark green rings with necrosis.

Systemic. The young leaves show chlorotic spots and later leaves have chlorotic ring and line patterns and are crinkled. There may be a slight malformation and dark green blisters.

Glycine max.

Local. No reaction.

Systemic. After a chlorotic spotting of the young leaves, later ones develop a mottle. They are slightly crinkled.

Lathyrus odoratus.

Local. Small chlorotic spots develop which later become necrotic.

Systemic. In 3 weeks the stem has become necrotic and the plant collapses.

Lupinus albus.

Local. No reaction.

Systemic. The young leaves develop chlorotic spots. Later ones are crinkled and rolled with chlorotic veinbands.

L. luteus.

Local. No reaction.

Systemic. The young leaves remain folded and have chlorotic spots. Later ones are crinkled or malformed, with an irregular chlorotic mottle. The plant is rosetted and stunted.

Melilotus officinalis.

Local. No reaction.

Systemic. There are chlorotic areas and a slight distortion.

Phaseolus acutifolius.

Local. No reaction.

Systemic. In 15 days there is a vein clearing, followed by a mottle with slight necrosis.

P. vulgaris var. Canadian Wonder.

Local. Within 5 days there are small chlorotic spots which later have a halo. Severe necrosis sets in, in the chlorosis (Fig. 5c).

Systemic. No reaction.

var. Haricot.

Local. In a week there are necrotic ringspots and veins.

Systemic. On some plants the young leaves show severe rolling and curling down. There are small chlorotic spots with necrotic veins and specks which spread until the plant collapses (Fig. 5d).

vars. Black Wonder, Idaho Refugee and Long Tom develop only local chlorotic rings or irregular areas in 3 to 6 days.

vars. S.A. Black and White and Tendergreen have no local reaction and only a transient vein clearing or spotting.

Pisum sativum.

Local. There may be necrotic rings and spots which cause the leaves to collapse.

Systemic. In 11 to 12 days the young leaves show a vein clearing or chlorotic flecks which soon become necrotic. This necrosis progresses down the stem and the growing point collapses. Secondary shoots may develop and these have malformed twisted and rosetted leaves with irregular chlorotic areas. The tendrils are abnormally curled (Fig. 5a).

Trifolium hybridum.

Local. No reaction.

Systemic. After 12 days there are chlorotic spots on the young leaves and later formed ones develop a streak mottle.

T. incarnatum.

Local. The leaves may collapse.

Systemic. In 12 days a vein clearing develops on the young leaves. Later leaves show a mosaic mottle and are crinkled and malformed. The plant is stunted.

Vicia faba.

Local. In 4 to 5 days large chocolate-coloured necrotic lesions develop. The leaves become flaccid (Fig. 5b).

Systemic. A week later small chlorotic spots or a vein clearing may occur on the young leaves. Usually the necrosis spreads quickly up the stem and into the growing point and the plant collapses.

Vigna unguiculata.

Local. In 5 days the leaves develop chlorotic spots with necrotic rings and veins. These soon drop.

Systemic. Only occasionally are there similar symptoms on the trifoliates, which collapse. If symptomless the virus can be recovered.

Voandzeia subterranea.

Local. No reaction.

Systemic. The young leaves develop a chlorotic spotting.

Natural source of virus: *Pisum sativum* (Northern Transvaal). The young leaves were mottled, the stems were necrotic and the growing points flaccid. The plants were stunted and rosetted and the tendrils abnormally curled.

Lathyrus odoratus (Pretoria and district). The leaves had a veinclearing, chlorotic spotting or veinbanding, with necrosis setting in. Some plants collapsed after this necrosis, while others produced secondary shoots with malformed, blistered leaves. Flowers on these stems showed a marked colour break.

Identification.

Several viruses show similar reactions on the pea, but cannot be considered the same as the above for the following reasons: Both pea American streak virus Zaumeyer (16) and Wisconsin pea stunt virus Hagedorn & Walker (5) are unable to infect the *Phaseolus* spp. which are hosts of this virus.

Pea Wisconsin streak virus Hagedorn & Walker (6) does not infect *Vicia faba* whereas this virus causes severe necrosis.

The pea stunt virus Zaumeyer (17) and the pea stunt virus strain Klesser (9) induce only a systemic reaction on the bean, while in addition the latter causes only a systemic chlorosis on the broad bean.

Pea New Zealand streak virus Chamberlain (2) infects severa lnon-legumes, induces different symptoms on many hosts and has different physical properties.

On the bean the symptoms are very like those caused by the lucerne mosaic virus, Weimer (15). Physical properties and legume host range are also similar, although lucerne mosaic virus is able to infect the non-legumes.

On pea and broad bean the symptoms resemble those of Zaumeyer's alfalfa mosaic viruses 1A and 1B (16), but neither of these induces a lethal necrosis of the sweet pea. Further, there is a considerable discrepancy in physical property values.

Apart from the necrotic reaction on the sweet pea this virus is almost identical with, and can be considered the same as the lucerne mosaic virus necrotic ring strain Klesser.

6. **Bean Local Chlorosis Virus—Strain B.**

Physical properties: Thermal inactivation point, 58-60°C. Longevity *in vitro*, 2–3 days. Dilution end point, 1: 1,000–1: 2,000.

Transmission: Mechanical sap inoculation. *Aphis craccivora.*

Host range: *Crotalaria spectabilis* Roth., *Glycine max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L., *L. luteus* L., *Phaseolus vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *Vicia faba* L., *Vigna unguiculata* (L.) Walp.

Reaction of Susceptible Species.

Crotalaria spectabilis.

Local. No reaction.

Systemic. After 7 days the young leaves show a vein clearing and spotting. Later leaves have irregular, almost white, streaks which lead to malformation of the leaf surface (Fig. 6c).

Glycine max.

Local. No reaction.

Systemic. A diffuse chlorotic mottle develops on most leaves.

Lathyrus odoratus.

Local. No reaction.

Systemic. After 11 days the young leaves show chlorotic streaks. This continues on later leaves or there is a mosaic. Necrotic streaks may occur on the stem and petioles. (Fig. 6f). There is a colour break on the flowers (Fig. 6e).

Lupinus albus.

Local. No reaction.

Systemic. After a vein clearing and spotting of the young leaves the next formed are crinkled with dark green blisters. There may be small necrotic speckles.

L. luteus.

Local. No reaction.

Systemic. Most leaves remain folded and have small chlorotic spots.

Phaseolus vulgaris var. Canadian Wonder.

Local. In 5 days vivid chlorotic spots appear (Fig. 6a).

Systemic. Shortly afterwards the young leaves also develop chlorotic spots and vein flecks (Fig. 6d). Later leaves are malformed and mottled (Fig. 6b). The old leaves show large chlorotic blotches.

Pisum sativum.

Local. No reaction.

Systemic. In 6 days there is a vein clearing and spotting of the young leaves. Later leaves are small and malformed with irregular dark green areas. The plant is rosetted and stunted and the tendrils are abnormally curled. There are necrotic stem streaks.

Trifolium hybridum.

Local. Small chlorotic spots develop.

Systemic. Most leaves have a chlorotic streak mosaic.

T. incarnatum.

Local. No reaction.

Systemic. In 16 days there is a vein clearing. Later leaves have a mosaic and are slightly malformed.

Vicia faba.

Local. No reaction.

Systemic. Chlorotic spots develop on the young leaves in a week. The next leaves all have a mosaic.

Vigna unguiculata.

Local. Small red necrotic lesions appear in 5 days.

Systemic. No reaction.

Natural source of virus: *Lathyrus odoratus* (Pretoria district). The leaves had chlorotic veinbands or streaks, and they were small and puckered.

Identification.

The vivid chlorotic spotting on the inoculated leaves of the bean is a characteristic feature of a group of viruses recorded in England by the writer.

The only published reports of similar viruses are those by Ainsworth and Zaumeyer.

Ainsworth (1) isolated a virus which caused a "sweet pea streak" and which induced a local chlorotic spotting on the bean. However, necrotic rings developed later on these leaves and the plant collapsed from a systemic necrosis, whereas this virus causes no necrosis on the bean.

On other plants there are also differences—on broad bean and sweet pea Ainsworth's virus resulted in a systemic necrosis whereas this virus induces a mottle or mosaic.

Zaumeyer's alfalfa yellow mosaic virus (18) causes symptoms on some varieties of bean which are very similar to those described for this virus, but on other varieties there is both a local and systemic necrosis.

However, on other host plants the symptoms differ. On broad bean and pea Zaumeyer's virus induces a local and systemic necrosis whereas this virus causes a mosaic on broad bean, and malformation and stunt on pea. On cowpea, there is a local necrosis as well as a yellow mottle and malformation with the alfalfa yellow mosaic, but only local lesions develop with this virus.

Further, Zaumeyer's virus has a larger host range which includes solanaceous spp., and the physical properties differ.

Although this virus was isolated from *Lathyrus odoratus* the disease it causes on that host is very similar to many others, but on *Phaseolus vulgaris* the symptoms are unusual.

Therefore the name chosen for this virus is bean local chlorosis virus. Of the three strains described in England (9) there is most similarity with the B strain—the A strain induces a local chlorosis on broad bean and a local and systemic necrosis on pea, whereas the C strain causes a veinbanding on broad bean and a mottle only on pea. Physical property values also differ.

This virus is therefore considered the same as bean local chlorosis virus—strain B.

7. **Bean Yellow Mosaic Virus, Necrotic Strain.**

Physical properties: Thermal inactivation point, 58–60°C. Longevity *in vitro*, 2–3 days. Dilution end point, 1: 1,000.

Transmission: Mechanical sap inoculation. *Aphis craccivora.*

Host range: *Crotalaria juncea* L., *C. spectabilis* Roth., *Glycine max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L., *L. mutabilis* Sweet., *L. luteus* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus* L., *P. vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *Vicia faba* L., *Voandzeia subterranea* Thouars.

Reaction of Susceptible Species.

Crotalaria juncea.

Local. No reaction.

Systemic. After 2 weeks the young leaves are chlorotic with dark green specks. Necrosis may set in, in the chlorosis and the plant may collapse. Usually the necrosis causes an uneven surface on the leaves which are small and malformed. The plant is stunted.

C. spectabilis.

Local. In 7 days there are chlorotic spots with a slight necrosis.

Systemic. At the same time the young leaves develop chlorotic spots or vein flecks. Later leaves are mottled and malformed with dark green blisters and necrotic specks. The plant is stunted.

Glycine max.

Local. No reaction.

Systemic. A diffuse chlorotic spotting develops.

Lathyrus odoratus.

Local. Some leaves become chlorotic (Fig. 7e).

Systemic. In 2 weeks the young leaves develop a vein clearing and chlorotic spotting. Later leaves are mottled and rolled (Fig. 7d).

Lupinus albus.

Local. No reaction.

Systemic. In 2 weeks the young leaves show a veinal necrosis. This may extend to the stem and the plant may collapse. Secondary shoots have small malformed and rolled leaves which are mottled. The plant is stunted.

L. mutabilis.

Local. No reaction.

Systemic. The young leaves curl back severely; there is a stem necrosis and the plant collapses.

L. luteus.

Local. No reaction.

Systemic. The young leaves remain folded and in 10 days there is a vein clearing and chlorotic spotting. The next ones are small and crinkled with dark green veinbands. Later leaves are almost stringlike. The plant is rosetted and stunted.

Melilotus officinalis.

A symptomless carrier.

Phaseolus acutifolius.

Local. No reaction.

Systemic. A diffuse chlorotic mottle develops on some leaves.

P. lunatus.

Local. No reaction.

Systemic. Only chlorotic vein flecks develop.

P. vulgaris var. Canadian Wonder.

Local. The leaves bend at right angles to the petiole and in 5–6 days there are chlorotic blotches and slightly necrotic veins (Fig. 7a). These leaves become leathery and remain attached.

Systemic. The first and second trifoliates also show a marked reflexing and they have chlorotic flecks or blotches. Later leaves develop a vein clearing, spotting or flecking and then a mottle. The next leaves are small and malformed and the plant is rosetted and stunted. The pods have sunken dark green areas (Fig. 7b).

var. Haricot.

Local. In 7 days there are chlorotic spots on the reflexed leaves.

Systemic. A week later, the first trifoliates bend down and show a vein clearing. Later leaves are mottled with dark green blisters. The plant is stunted, and the stem may have short necrotic streaks. The pods develop sunken necrotic rings.

vars. Black Wonder, Idaho Refugee, Long Tom and Tendergreen develop symptoms similar to those on Canadian Wonder.

var. S.A. Black and White shows no local reaction but the systemic is similar to Canadian Wonder.

Pisum sativum.

Local. In 6 days there may be necrotic rings or the leaves just wilt and collapse.

Systemic. Soon afterwards the young leaves develop a vein clearing and chlorotic spotting. Necrosis sets in on the leaves, stipules and stem, and the growing point collapses (Fig. 7f). Secondary shoots are stunted and rosetted, and the leaves are small, malformed and mottled. The tendrils are abnormally curled.

Trifolium hybridum.

Local. No reaction.

Systemic. After 3 weeks the young leaves show a vein clearing and chlorotic spotting. Later ones develop vivid yellow streaks and a slight puckering (Fig. 7c).

T. incarnatum.

Local. No reaction.

Systemic. After 2 weeks there is a vein clearing of the young leaves followed by a chlorotic veinbanding. The leaves are slightly puckered and the plant is stunted.

Vicia faba.

Local. No reaction.

Systemic. In 7 days the young leaves show a vein clearing, or chlorotic spots or flecks. Later leaves develop a mosaic.

Voandzeia subterranea.

Local. No reaction.

Systemic. Diffuse chlorotic spots develop on some leaves.

Natural source of virus: *Lathyrus odoratus* (Pretoria district). The leaves had chlorotic spots, veinbands or a mottle, and there was a colour break of the flowers.

Identification.

There are several viruses which cause a reflexing of the bean leaves, but only with alsike clover mosaic virus 2 Zaumeyer (17) is this characteristic associated with a systemic necrosis on the pea. However, as the necrosis caused by the alsike virus results in the complete defoliation of the pea plant, and the physical properties differ, the casual virus is not the same as the one described here.

Although the type bean yellow mosaic virus Pierce (11) does not induce a necrosis on the pea, symptoms on many other hosts and the physical properties are very similar to this virus.

The bean yellow mosaic virus necrotic lesion strain of Zaumeyer and Fisher (19) is not infectious to pea, white lupin or crimson clover, all of which are hosts to this virus. Further, it induces a local and systemic necrosis on broad bean (whereas this virus causes a mosaic) and local lesions on tobacco, which is not susceptible to this virus.

The severe yellow strain of Thomas and Zaumeyer (13) is excluded as there are differences in the symptoms on several host plants and in the physical property values. It is also able to infect tobacco.

The bean yellow mosaic virus " Isolate I " of Hagedorn and Walker (7) does not cause any necrosis on the pea and other symptoms and properties also differ.

Although the virus described here does not infect the cowpea and remains latent in sweet clover, so many details are similar to a virus found in England by the writer (9), that it is considered to be the same, and is named bean yellow mosaic virus, necrotic strain.

8. **Tomato spotted Wilt Virus.** Samuel *et al.*

Physical properties: Thermal inactivation point, 40–42°C. Longevity *in vitro*, –1 day. Dilution end point, 1: 5,000–1: 10,000.

Transmission: Mechanical sap inoculation. *Thrips* spp.

Host range in *Leguminosae: Arachis hypogaea* L., *Crotalaria juncea* L., *C. spectabilis* Roth., *Glycine max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L., *L. luteus* L., *Medicago denticulata* L., *M. sativa* L., *Melilotus officinalis* Willd., *Phaseolus mungo* L., *Pisum sativum* L., *Trifolium fragiferum* L., *T. incarnatum* L., *T. pratense* L., *Vicia faba* L., *Vigna unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

Reaction of Susceptible Species.

Arachis hypogaea.

Local. Usually no reaction.

Systemic. There is a veinal necrosis of the young leaves and the growing point collapses. Secondary shoots are rosetted, with small, malformed leaves. These have concentric chlorotic patterns or dark green veinbands. Necrotic speckling may be severe.

Crotalaria juncea.

Local. There are necrotic spots in 5 days which enlarge by concentric bands (Fig. 8h).

Systemic. There are concentric chlorotic patterns and possibly a lethal necrosis.

C. spectabilis.

Local. Necrotic ringspots develop in 5 days. Later there is also a veinal necrosis (Fig. 8b).

Systemic. Some leaves are severely curled and have a chlorotic network.

Glycine max.

Local. There are necrotic specks with chlorotic haloes. The leaves later become almost orange (Fig. 8e).

Systemic. No reaction.

Lathyrus odoratus.

Local. Large necrotic lesions develop and the leaves soon abciss.

Systemic. The necrosis spreads into the main stem causing external streaks, and the plant eventually collapses.

Lupinus albus.

Local. Necrotic specks develop and the rest of the leaflet becomes chlorotic. The necrosis spreads and the leaflets drop (Fig. 8 j).

Systemic. No reaction.

L. luteus.

Local. There are chlorotic rings which soon become necrotic and the leaflets abciss.

Systemic. No reaction.

Medicago denticulata.

Local. A scorch necrosis causes a defoliation.

Systemic. There is a vein clearing of the young leaves followed by a veinal necrosis. Later leaves have necrotic ringspots (Fig. 8f).

M. sativa.

Local. There are necrotic ringspots on a vivid yellow background (Fig. 8i).

Systemic. No reaction.

Melilotus officinalis.

Local. Chlorotic ringspots develop in 10–11 days.

Systemic. No reaction.

Phaseolus mungo.

Local. Isolated necrotic lesions develop.

Systemic. No reaction.

Pisum sativum.

Local. After a general necrosis the leaves wilt.

Systemic. A veinal necrosis of the leaves follows, and young plants may collapse. On older plants there are necrotic spots on the leaves and necrotic streaks on the stems. (Fig. 8c). The pods may have necrotic lesions and the tendrils are abnormally curled.

Trifolium fragiferum.

Local. There are necrotic specks with chlorotic haloes in 5 days (Fig. 8g).

Systemic. No reaction.

T. incarnatum.

Local. Chlorotic spots with necrotic rings develop and there is a slight veinal necrosis.

Systemic. No reaction.

T. pratense.

Local. There are necrotic specks which enlarge and fuse to give a "scorch" effect.

Systemic. No reaction.

Vicia faba.

Local. A severe veinal necrosis may develop.

Systemic. Usually this necrotic effect is first seen on the young leaves. It is soon followed by sunken necrotic stem streaks and a collapse of the plant (Fig. 8a).

Vigna unguiculata.

Local. There are red necrotic spots with chlorotic rings.

Systemic. No reaction.

Voandzeia subterranea.

Local. Necrotic spots develop which later enlarge by concentric bands.

Systemic. A diffuse chlorotic mottle may occur.

Natural source of virus: The natural incidence of spotted wilt is high on peas, sweet peas and broad beans. On groundnuts and the *Crotalaria* spp. it occurs less frequently.

Identification.

Sub-inoculations to several Solanaceous hosts proved that this is the tomato spotted wilt virus (12).

HOST RANGES.

Host Plant.	1. Pea Mosaic Virus.	2. Pea Virus 2.	3. Pea Stunt Virus.	4. Pea Wilt Virus Strain.	5. Lucerne Mosaic Virus Strain.	6. Bean Local Chlorosis Virus B.	7. Bean Yellow Mosaic Virus Strain.	8. Tomato Spotted Wilt Virus.
Arachis hypogaea		−	−	+	−	−	−	+
Crotalaria juncea	+	−	+	+	+	−	+	+
C. spectabilis	−	−	+	+	+	+	+	+
Dolichos lablab	−			+			−	
Glycine javanica	+	−		+			−	
G. max		−	+	+	+	+	+	+
Lathyrus odoratus	+	+	+	+	+	+	+	+
Lupinus albus	+	+	+	+	+	+	+	+
L. luteus	+		+	+	+	+	+	+
Medicago lupulina	+	+		+		−		
M. sativa			+					+
Melilotus officinalis	+			+	+	−	+	+
Phaseolus acutifolius				+	+	−	+	
P. lunatus	−			+	−	−	−	
P. mungo	+			+	−	−	−	+
P. vulgaris	+ ?	+	+	+	+	+	+	−
Pisum sativum	+	+	+	+	+	+	+	+
Trifolium fragiferum	−			−			−	+
T. hybridum	+	+	+	+	+	+	+	−
T. incarnatum	+		+	+	+	+	+	+
T. pratense	+	+		+	−	−	−	+
T. repens	−						−	−
Vicia faba	+	+	+	+	+	+	+	+
Vigna sesquipedalis			+	+			−	
V. unguiculata	−	−	+	+	+	+	−	+
Voandzeia subterranea	−		+	+	+	−	+	+

PHYSICAL PROPERTIES AND METHODS OF TRANSMISSION.

Virus.	Thermal Inactivation Point °C.	Longevity *in vitro* Days.	Dilution End Point.	Transmission.		
				Sap.	Seed.	Aphid.
1. Pea mosaic virus	56–58	2–3	1: 1,000–1: 2,000	+	−	+
2. Pea virus 2	60–62	3–4	1: 1,000–1: 2,000	+	−	+
3. Pea stunt virus	60–62	2–3	1: 5,000–1: 10,000	+	−	−
4. Pea wilt virus strain	58–60	2–3	1: 10,000	+	−	+
5. Lucerne mosaic virus necrotic ring strain	62–65	7–8	1: 3,000–1: 5,000	+	−	+
6. Bean local chlorosis virus B.	58–60	2–3	1: 1,000–1: 2,000	+	−	+
7. Bean yellow mosaic virus necrotic strain	58–60	2–3	1: 1,000	+	−	+
8. Tomato spotted wilt virus	40–42	–1	1: 5,000–1: 10,000	+	−	−

SYMPTOMS ON THE MAIN TEST PLANTS.

Virus.	*Phaseolus vulgaris.*	*Vicia faba.*	*Pisum sativum.*
1. Pea mosaic virus	Loc. no reaction Syst. chl. blo. (?)	Loc. no Syst. mosaic	Loc. no Syst. mosaic, ros.
2. Pea virus 2	Loc. no Syst. csp., stunt	Loc. no Syst. csp. mosaic	Loc. necrosis. Syst. mosaic, ros.
3. Pea stunt virus	Loc. no Syst. mot., stunt	Loc. no Syst. mos., 1 & n.	Loc. no Syst. mos., necr. s.s.
4. Pea wilt virus strain	Loc. no Syst. mot.	Loc. necr. rings Syst. no	Loc. coll. Syst. mot., necr. s.s.
5. Lucerne mosaic virus necrotic ring strain	Loc. csp., necr. O Syst. no	Local. necr. sp. Syst. c.sp., necr. coll.	Loc. necr. O Syst. c.fl., necr. coll.
6. Bean local chlorosis virus B	Loc. vivid c.sp. Syst. mos., malf.	Loc. no Syst. c.sp., mos.	Loc. no Syst. c.sp., malf., necr. s.s.
7. Bean yellow mosaic virus necrotic strain	Loc. reflexing Syst. 7, mot., malf.	Loc. no Syst. c.sp., mos.	Loc. necrosis Syst. necr. coll.
8. Tomato spotted wilt virus	Loc. no Syst. no	Loc. necrosis Syst. necr. coll.	Loc. necrosis Syst. necr. coll.

ABBREVIATIONS USED:

blo.—blotches.
c., chl.—chlorotic.
coll.—collapse.
fl.—flecks.
loc.—local.
1 & n—long and narrow leaves.
malf.—malformation.
mos.—mosaic.
mot.—mottle.
necr.—necrotic/necrosis.
no—no reaction.
ros.—rosette.
sp.—spots.
s.s.—stem streaks.
syst.—systemic.
O.—rings.
7—reflexing.

SUMMARY.

The virus diseases which occur naturally on peas and sweet peas in South Africa are described in detail.

In the field, peas develop mosaic and/or necrotic symptoms. The mosaic is caused by the pea mosaic virus or pea virus 2; the necrosis (and ultimate collapse) by the lucerne mosaic virus necrotic ring strain or by the tomato spotted wilt virus; and a mosaic with necrotic stem streaks by pea stunt virus or a strain of the pea wilt virus.

Symptoms on naturally infected sweet peas are similar viz. a mosaic develops with the pea mosaic virus, the necrotic strain of bean yellow mosaic or the bean local chlorosis virus B. A necrosis develops with the lucerne mosaic virus necrotic ring strain or with the tomato spotted wilt virus; and mosaic plus necrotic stem streaks develops with the pea stunt virus.

Of these, tomato spotted wilt has already been reported as a virosis of legumes in South Africa, but the others are new records.

Pea mosaic virus, pea virus 2 and pea stunt virus were identified by comparing with published descriptions.

Three others were found to be very similar to, but not identical with previously described viruses, and are considered to be strains of the type viruses, viz. a strain of the pea wilt virus, bean yellow mosaic virus necrotic strain, and lucerne mosaic virus necrotic ring strain.

One is apparently a new entity, and is named bean local chlorosis virus B, after the characteristic reaction on the bean.

LITERATURE CITED.

1. Ainsworth, G. C. (1940)..... The identification of certain viruses found infecting leguminous plants in Great Britain. Ann. Appl. Biol., 27: 218–226.
2. Chamberlain, E. E. (1939)..... Pea streak (*Pisum* virus 3). N.Z. Jour. Sci. and Tech. 20: 365A–381A.
3. Doidge, E. M., Bottomley, A. M., van der Plank J. E. and Pauer, G. E. (1953) A revised list of plant diseases occuring in South Africa. Dept. of Agric. Sci. Bull. 346.
4. Doolittle, S. P. and Jones F. R. (1925) The mosaic disease in the garden pea and other legumes. Phytopathology 15: 763–772.
5. Hagedorn, D. J. and Walker, J. C. (1949) Wisconsin pea stunt, a newly described disease. Jour. Agric. Res., 78: 617–626.
6. Hagedorn, D. J. and Walker, J. C. (1949) Wisconsin pea streak. Phytopathology, 39: 837–847.
7. Hagedorn, D. J. and Walker, J. C. (1950). The relation of bean virus 2 to pea mosaic in Wisconsin. Phytopathology, 40: 684–698.
8. Johnson, F. (1942)..... The complex nature of white clover mosaic. Phytopathology, 32: 103–116.
9. Klesser, P. J. (1951)..... Ph. D. thesis. Cambridge University.
10. Osborn, H. T. (1937)..... Studies on the transmission of pea virus 2 by aphids. Phytopathology, 27: 589–603.
11. Pierce, W. H. (1934)..... Viroses of the bean. Phytopathology, 24: 87–115.
12. Samuel, G., Bald, J. G., and Pittman, H. A. (1930) Investigations on spotted wilt of tomatoes. Aust. Counc. Sci. Ind. Res. Bull., 44.
13. Thomas, H. R. and Zaumeyer, W. J. (1953) A strain of yellow bean mosaic virus producing local lesions on tobacco. Phytopathology, 43: 11–15.
14. Wade, B. L. and Zaumeyer, W. J. (1938) Varietal reaction of pea to a virus from alsike clover. Phytopathology, 28: 505–511.
15. Weimer, J. L. (1934)..... Studies on alfalfa mosaic. Phytopathology, 24: 239–247.
16. Zaumeyer, W. J. (1938)..... A streak disease of peas and its relation to several strains of alfalfa mosaic virus. Jour. Agric. Res., 56: 747–772.
17. Zaumeyer, W. J. (1940)..... Three previously undescribed mosaic diseases of pea. Jour. Agric. Res., 60: 433–452.
18. Zaumeyer, W. J. (1953)..... Alfalfa yellow mosaic virus systemically infectious to beans. Phytopathology, 43: 38–42.
19. Zaumeyer, W. J. and Fisher, H. H. (1953) A new necrotic lesion-producing strain of yellow bean mosaic. Phytopathology, 43: 45–49.

FIG. 1.—PEA MOSAIC VIRUS.

A. *Pisum sativum*. B. *Trifolium incarnatum*. C. *Lathyrus odoratus*. D. *Lupinis albus*.

FIG. 2.—PEA VIRUS 2.

A. *Pisum sativum*. B. *Phaseolus vulgaris*. C. *Vicia faba*. D. *Lupinus albus*.

FIG. 3.—PEA STUNT VIRUS.
A. *Pisum sativum.* B. and C. *Phaseolus vulgaris.* D. *Vicia faba.*

FIG. 4.—PEA WILT VIRUS, STRAIN.

A. *Pisum sativum*. B. *Vicia faba* (local lesions). C. *Trifolium pratense*. D. *Phaseolus vulgaris*.

FIG. 5—LUCERNE MOSAIC VIRUS, NECROTIC RING STRAIN.

A. *Pisum sativum*. B. *Vicia faba* (local lesions). C. *Phaseolus vulgaris* var. Canadian Wonder (local lesions). *D. Phaseolus vulgaris* var. Haricot.

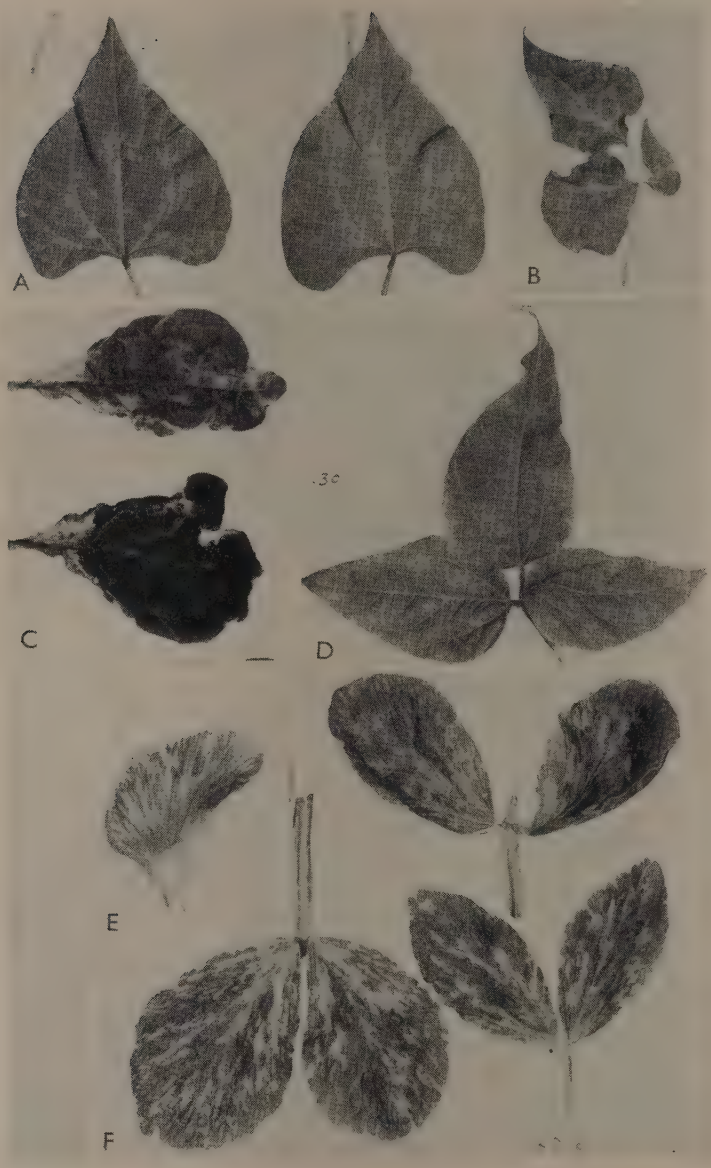

FIG. 6.—BEAN LOCAL CHLOROSIS VIRUS B.
A., B. and D. *Phaseolus vulgaris* A. local lesions. B. and D. systemic reaction. C. *Crotalaria spectabilis*. E. and F. *Lathyrus odoratus*.

FIG. 7.—BEAN YELLOW MOSAIC VIRUS, NECROTIC STRAIN.

A. and B. *Phaseolus vulgaris*. C. *Trifolium hybridum*. D. and E. *Lathyrus odoratus*. F. *Pisum sativum*.

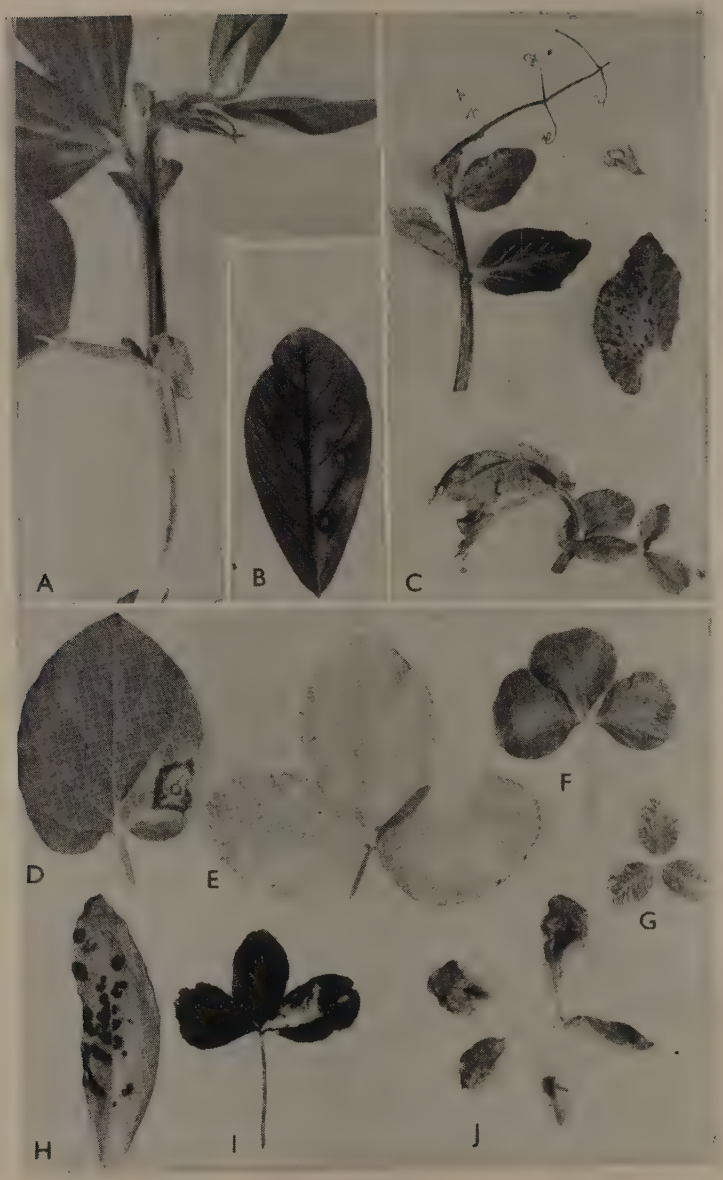

FIG. 8.—TOMATO SPOTTED WILT VIRUS.

A. *Vicia faba*. B. *Crotalaria spectabilis*. C. *Pisum sativum*. D. *Nicotiana glutinosa*. E. *Glycine max*. F. *Medicago denticulata*. G. *Trifolium fragiferum*. H. *Crotalaria juncea*. I. *Medicago sativa*. J. *Lupinus albus*.

Virus Diseases of Broad Beans.

By

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Broad beans are not grown extensively in South Africa. The viruses described here were found on naturally infected *Vicia faba* plants grown in isolated areas of the Transvaal, and they are possibly not characteristic for the whole country.

In the field, the symptoms are: mosaic, mosaic with stunt, or severe necrosis and collapse.

The viruses causing mosaic symptoms are found frequently. An unusual feature of this mosaic is the fact that the chlorotic areas are depressed below the normal surface of the leaf.

The systemic necrosis is caused by the tomato spotted wilt virus, which is described in detail in the paper on pea virus diseases. The incidence of this disease can be fairly high, with severe crop losses; but usually it occurs only sporadically thoughout a planting.

REVIEW OF LITERATURE.

Although Elliot transmitted a mosaic from clover to broad bean in 1921, the first descriptions of naturally occurring mosaic diseases of broad bean were those of Böning 1927, van der Meulen 1928, Merkel 1929 and Fukushi 1930.

Imai 1934 successfully transmitted a virus causing mosaic on broad bean, to broad bean, pea and sweet pea, by both aphids and sap.

Further reports of broad bean mosaics came from Gigante in Italy (9); Yu in China (25); d'Oliviera in Portugal (5); and Quantz in Germany (17).

Murayama (14) determined the physico-chemical properties of a mosaic of broad beans in Japan.

Pierce (16) described the broad bean local lesion virus which he isolated from red clover, and which Weiss (22) considers to be the same as the pea wilt virus of Johnson (12).

Weiss regards the mosaic virus of Böning as being identical with the common pea mosaic virus. Further, he groups the viruses of Merkel, Murayama and Yu together, and suggests a relationship with either the bean yellow mosaic or the pea mottle viruses.

Other types of viroses found naturally on broad bean are the mild mosaic and rosette of Yu (25, 26); a vascular wilt—Stubbs (20); a mottle—Bawden, Chaudhuri & Kassanis (1); a soil-borne necrotic mosaic—Fujikawa (7) and tomato spotted wilt, Yu (27).

Rubio & van Slogteren studied the X-bodies associated with the mottle virus (18).

When artificially inoculated, broad beans develop systemic mosaic or necrotic symptoms with most of the legume viruses (10, 15, 16, 28, 29, 30, 31, 32) and also with the tobacco ringspot virus (24) and the curly top virus (19).

With celery virus 1, only local lesions develop (23).

METHODS AND MATERIALS.

Naturally infected broad bean plants were collected from several parts of the Transvaal. The viruses were inoculated to a number of species of *Leguminosae*, and also to several Solanaceous plants. (None of the latter was susceptible).

Carborundum power was used for the sap inoculations and *Aphis fabae* and *A. craccivora* for the insect transmission tests.

1. Broad Bean Mosaic Virus A.

Physical properties: Thermal inactivation point, 55–56°C. Longevity *in vitro*, 2–3 days. Dilution end point, 1: 1,000.

Transmission: Mechanical sap inoculation. *Aphis fabae*.

Host range: *Arachis hypogaea* L., *Crotalaria juncea* L., *C. spectabilis* Roth., *Glycine max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L., *L. luteus* L., *L. mutabilis* Sweet., *Medicago lupulina* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus* L., *P. mungo* L., *P. vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *T. pratense* L., *Vicia faba* L., *Vigna sesquipedalis* (L.) Wight., *V. unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

Reaction of Susceptible Species.

Arachis hypogaea.

Local. No reaction.

Systemic. There is a diffuse chlorotic mottle.

Crotalaria juncea.

Local. There are necrotic spots after 8 days. These fuse and the leaves drop.

Systemic. In 12 days necrosis has spread up the stem and into the veins of the young leaves (Fig. 1b). The plant may collapse or may have malformed rolled leaves, with dark green blisters.

C. spectabilis.

Local. No reaction.

Systemic. After 3 weeks the young leaves develop irregular chlorotic areas, which cause a malformation of the leaves, due to uneven growth of the laminae. Soon necrosis sets in in these areas. Later formed leaves have chlorotic line patterns which become necrotic to produce an " etched " effect. Older leaves may show necrotic rings without any chlorosis.

Glycine max.

Local. No reaction.

Systemic. A few leaves show a chlorotic mottle, the young leaves being symptomless. Some old leaves have vivid yellow spots with central necrotic specks.

Lathyrus odoratus.

Local. No reaction.

Systemic. Most leaves are rolled and have dark green streaks.

Lupinus albus.

Local. Chlorotic spots with dark green rings can be seen after 11 days. The leaflets drop.

Systemic. The young leaves show a vein clearing, and they remain folded and have wavy margins. Later leaves develop small chlorotic spots and then dark green blisters. The latter leaves are crinkled and may be malformed. The growing point is rosetted and stunted.

L. luteus.

Local. No reaction.

Systemic. In 8 to 9 days small chlorotic spots develop on the young leaves. After 3 weeks most leaves are small, malformed and mottled. The plant is stunted. There may be enough necrosis to cause the collapse of the plant.

L. mutabilis.

Local. No reaction.

Systemic. The young leaves have chlorotic specks. Later ones are chlorotic with dark green blisters and malformation. The plant is rosetted.

Medicago lupulina.

Local. No reaction.

Systemic. The young leaves develop chlorotic streaks and later leaves are mottled and slightly puckered.

Melilotus officinalis.

Local. No reaction.

Systemic. The plant is stunted and the leaves have chlorotic vein streaks.

Phaseolus acutifolius.

Local. In 4 days there are chlorotic spots and the veins become necrotic.

Systemic. After 12 days the young leaves develop a vein clearing with small chlorotic spots. There is necrosis in the chlorosis (Fig. 1e) and the growing point may collapse. Later formed leaves are mottled.

P. lunatus.

Local. In 7 to 8 days necrotic lesions develop and there are large chlorotic areas.

Systemic. The necrosis spreads quickly into the stem and veins of the young leaves, and the plant collapses.

P. mungo.

Local. No reaction.

Systemic. A diffuse spot mottling develops.

P. vulgaris var. Canadian Wonder.

Local. There are irregular chlorotic areas which fuse to a general chlorosis.

Systemic. In 6 days the young leaves show a vein clearing. Later leaves develop a diffuse chlorotic spotting and the older leaves have large chlorotic blotches.

var. Haricot.

Local. Within a week there are chlorotic blotches.

Systemic. At the same time the young leaves curl down severely. They are crinkled and chlorotic.

Pisum sativum.

Local. In 8 days the leaves show small necrotic specks.

Systemic. Soon after, the young leaves develop a vein clearing with small necrotic specks. Later leaves and stipules are all similarly speckled and the stem develops purple necrotic streaks which may result in the collapse of the plant. If not, the leaves are rosetted and folded with irregular dark green areas and the tendrils are abnormally curled.

Trifolium hybridum.

Local. No reaction.

Systemic. Most leaves show a chlorotic streak mottle and slight crinkle after about 3 weeks.

T. incarnatum.

Local. No reaction.

Systemic. After 9 days the young leaves show a vein clearing. Later leaves have irregular chlorotic areas and are crinkled. Some may have necrotic spots or veins (Fig. 1c).

T. pratense.

Local. No reaction.

Systemic. A chlorotic streak mottle develops (Fig. 1d).

Vicia faba.

Local. No reaction.

Systemic. In 9 days the young leaves show a vein clearing. Later formed leaves develop chlorotic spots or dark green streaks and then a mosaic. A characteristic of this mosaic is that the chlorotic areas are sunken below the leaf surface, resulting in the dark green streaks being apparently raised. (Fig. 1a). The leaves are also rolled and the plant is slightly stunted.

Vigna sesquipedalis.

Local. Isolated chlorotic areas develop.

Systemic. Only the first and second trifoliates show a diffuse chlorotic mottle.

V. unguiculata.

Local. There are chlorotic spots in 4 days, and the leaves become flaccid and drop.

Systemic. After 9 to 10 days the young leaves develop a vein clearing. Later ones are diffusely mottled.

Voandzeia subterranea.

Local. No reaction.

Systemic. After 3 weeks the leaves show a chlorotic network and irregular chlorotic areas.

Natural source of virus: *Vicia faba*. The plants were slightly stunted and the leaves were rolled and elongated. They had a mosaic mottle with the chlorotic areas depressed below the dark green or normal coloured areas.

Identification.

The characteristic symptom of this virus on broad bean, is a mosaic with the chlorotic areas depressed. This apparently occurs with only one other described virus.

Böning (3) mentions a similar effect with his virus, which was later identified as the common pea mosaic virus. However, the pea mosaic is not transmissible to bean (which is a host of this virus) and causes a mosaic on pea and not a necrosis which is usual with this virus.

Although pea virus 2 Osborn (15) is able to infect bean, the symptoms on pea are again chlorotic and not necrotic.

This necrotic reaction on pea can be compared with several others:

(*a*) The alfalfa mosaic virus 1B Zaumeyer (29) causes a similar local and systemic necrosis on the pea, but only a local necrotic spotting on the bean, whereas this virus induces a mottle only. Moreover this alfalfa mosaic results in a necrotic collapse of the broad bean.

(*b*) The pea American streak virus Zaumeyer (28) is non-infectious to the bean, causes a local reaction on broad bean and withstands a temperature of 10° higher than this virus.

(*c*) The pea Wisconsin streak virus Hagedorn & Walker (10) is not able to infect either bean or broad bean.

(*d*) The pea New Zealand streak virus Chamberlain (4) causes a local and systemic necrosis of the bean (whereas this virus induces a mottle only), and broad bean is not included in the host range. Further, there is a great difference in the physical property values of the 2 viruses.

(*e*) The alsike clover mosaic virus Zaumeyer & Wade (32) results in a conspicuous reflexing of the bean leaves, which does not occur with this virus.

(*f*) The white clover mosaic virus complex Zaumeyer & Wade (31) induces a necrosis on both the bean and broad bean, both of which show a mottle with this virus.

(*g*) Although the symptoms of the pea stunt virus Zaumeyer (30) on pea and bean are similar to this virus, symptoms on other hosts, the host range and the physical property values are different.

Pierce's broad bean local lesion virus (16) causes only a local necrosis on broad bean, while Stubbs' virus (20) induces a severe systemic necrosis.

The mild mosaic virus of Yu (25) is unable to infect bean, cowpea and soybean (all of which are hosts of this virus) and does not withstand more than 3 hours ageing, whereas this virus lasts 2–3 days *in vitro*.

The broad bean mottle virus Bawden, Chaudhuri & Kassanis (1) induces symptoms similar to this virus on bean, pea, sweet pea and the clovers, but differs on soybean and broad bean. (During the initial subinoculations with the mottle virus, broad bean developed a systemic necrosis as well, but later, only a mottle). However, Bawden's virus withstood heating up to 95°C., and ageing up to 20 days. Further it was not transmissible by any of the *Aphis* species.

As this virus cannot be fully identified with any previously described, it may be a new virus or strain. It is named broad bean mosaic virus A.

2. Broad Bean Mosaic Virus B.

Physical properties: Thermal inactivation point, 56–58°C. Longevity *in vitro*, 1–2 days. Dilution end point, 1: 1,000.

Transmission: Mechanical sap inoculation. *Aphis craccivora.*

Host range: *Crotalaria juncea* L., *C. spectabilis* Roth., *Lupinus albus* L. vars. sweet and bitter, *Phaseolus lunatus* L., *P. vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *Vicia faba* L., *Vigna sesquipedalis* (L.) Wight., *V. unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

Reaction of Susceptible Species.

Crotalaria juncea.

Local. No reaction.

Systemic. In 8 days the young leaves develop a vein clearing and spotting. The next leaves have chlorotic streaks which lead to a malformation. Later leaves are small and rolled and have dark green blisters. (Fig. 2e). The plant is stunted.

C. spectabilis.

Local. No reaction.

Systemic. In 13 days there are chlorotic spots and vein flecks on the young leaves. Later leaves have broad alternate chlorotic and green veinbands (Fig. 2c). There may be necrotic stem streaks.

Lupinus albus var. Sweet.

Local. After 13 days the leaves have chlorotic spots with necrotic veins, and they soon drop.

Systemic. At the same time the young leaves remain folded and have small chlorotic spots. Later formed leaves are small, malformed and mottled. The growing point is rosetted and the plant stunted.

var. Bitter.

Local. No reaction.

Systemic. The first leaves are mottled. Later the growing point becomes rosetted with small chlorotic leaves. There may be necrotic stem streaks.

Phaseolus lunatus.

Local. No reaction.

Systemic. After 3 weeks chlorotic vein flecks develop (Fig. 2b).

P. vulgaris var. Canadian Wonder.

Local. In 11 to 12 days large chlorotic blotches appear.

Systemic. The first few trifoliates develop large chlorotic areas (Fig. 2d). New leaves are symptomless.

var. Haricot.

Local. In 10 to 12 days there are small chlorotic areas.

Systemic. Soon after, the young leaves curl down and have a chlorotic network. Later formed leaves are small, puckered and mottled.

Pisum sativum.

Local. No reaction.

Systemic. After 11 to 12 days the young leaves show a vein clearing and spotting. The next formed leaves develop a mosaic, and the tendrils are abnormally curled. Necrosis of the growing point leads to the eventual collapse of the plant.

Trifolium hybridum.

A symptomless carrier.

T. incarnatum.

Local. No reaction.

Systemic. The young leaves show a chlorotic network and flecking in 11 days. Later leaves are crinkled and have a mosaic mottle. (Fig. 2a). The plant is severely stunted.

Vicia faba.

Local. No reaction.

Systemic. In 18 days chlorotic spots develop on the young leaves. Later leaves show a mosaic with the chlorotic areas depressed, leaving raised dark green islands.

Vigna sesquipedalis.

Local. No reaction.

Systemic. There is a chlorotic network followed by a chlorotic spotting.

V. unguiculata.

Local. No reaction.

Systemic. The young leaves show small chlorotic specks after 18 days. Later ones are chlorotic with short dark green veinbands, and are rolled downwards.

Voandzeia subterranea.

A symptomless carrier.

Natural source of virus: *Vicia faba.* Although the mosaic symptoms on the leaves were similar to those on the plants from which the A virus was isolated, there was little stunt or rolling. The general appearance of the plants was normal.

Crotalaria spectabilis. Most leaves had bands of vivid yellow and dark green. There was also a slight veinal necrosis.

Identification.

This virus is very similar to the previous one, but differences in host range, physical property values and symptoms on some plants are too marked for it to be classified as the same.

As this virus also results in the typical sunken chlorotic reaction on the broad bean, it is named broad bean mosaic virus B.

SYMPTOM DIFFERENCES BETWEEN BROAD BEAN MOSAIC VIRUSES A AND B.

Host plant.	Virus A.	Virus B.
Crotalaria juncea.....	Loc. necr. spots. Syst. necr. coll.	Loc. no reaction. Syst. chl. str., d.gr. bl., malf.
C. spectabilis.....	Loc. no. Syst. irreg. chl., malf., necr. patterns.	Loc. no. Syst. chl. spots, d.gr. veinb., necr. s.s.
Phaseolus lunatus.....	Loc. necr. lesions. Syst. necr. coll.	Loc. no. Syst. chl. flecks.
Pisum sativum.....	Loc. necr. specks. Syst. necr. specks, coll.	Loc. no. Syst. mos., necr. coll.
Trifolium hybridum.....	Loc. no. Syst. chl. streak mot.	Symptomless carrier.
Vigna sesquipedalis..... *V. unguiculata*.....	Loc. chl. spots. Syst. chl. mot.	Loc. no. Syst. chl. spots or veinb.
Voandzeia subterranea.....	Loc. no. Syst. chl. veins and areas.	Symptomless carrier.

Abbreviations used:—

bl.—blisters.
chl.—chlorosis/chlorotic.
coll.—collapse.
d. gr.—dark green.
irreg.—irregular.
malf.—malformed.
mos.—mosaic.
mot.—mottle.
no.—no reaction.
necr.—necrosis/necrotic.
n.s.s.—necrotic stem streak.
str.—streaks.
veinb.—veinbands.

PHYSICAL PROPERTIES AND METHODS OF TRANSMISSION.

Virus.	Thermal inactivation point °C.	Longevity *in vitro* Days.	Dilution end point.	Transmission.		
				Sap.	Seed.	Aphis.
A.....	55–56	2–3	1: 1,000	+	—	+
B.....	56–58	1–2	1: 1,000	+	—	+

HOST RANGES.

Host plant.	Virus A.	Virus B.
Arachis hypogaea	−	
Crotalaria juncea	−	−
C. spectabilis	−	−
Dolichos lablab		−
Glycine javanica		−
G. max	−	− (?)
Lathyrus odoratus	−	− (?)
Lupinus albus	−	−
L. luteus	−	−
L. mutabilis	−	−
Medicago lupulina	−	−
M. sativa	−	
Melilotus officinalis	−	
Phaseolus acutifolius	−	
P. lunatus	−	+
P. mungo	−	
P. vulgaris	−	+
Pisum sativum	−	+
Trifolium fragiferum	−	
T. hybridum	−	−
T. incarnatum	−	
T. pratense	−	
T. repens	−	−
Vicia faba	−	+
Vigna sesquidedalis	−	+
V. unguiculata	−	−
Voandzeia subterranea	−	−

LITERATURE CITED.

1. Bawden, F. C., Chaudhuri, R. P. and Kassanis, B. (1951) Some properties of the broad-bean mottle virus. Ann. Appl. Biol., 38: 774–784.
2. Berkeley, G. H. (1947)..... Alfalfa mosaic on pepper in Ontario. Phytopathology (Abstr.), 37: 3.
3. Böning, K. (1927)..... Die mosaikkrankheit der Ackerbohne (*Vicia faba* L.) Ein Beitrag zu dem Mosaik der Papilionaceae. Forsch. auf dem Gebiet der Pflanzenkrankh. und der Immunität im Pflanzenreich, 4: 43–111.
4. Chamberlain, E. E. (1939)..... Pea Streak (*Pisum* virus 3). N.Z. Jour. Sci. & Tech., 20: 365A–381A.
5. d'Oliviera, Maria de L. (1946).. O " mosaico " de Faviera e suas relações com outras Leguminosas. Brotéria, 15: 90–94. (Abstr. R.A.M., 26: 372).
6. Elliott, J. A. (1921)..... A mosaic of sweet and red clovers. Phytopathology, 11: 146–148.
7. Fujikawa, T. (1955)..... Studies on the necrotic mosaic of broad bean. Agric. & Hort., 30: 721–722. (Abstr. R.A.M., 35: 742.)
8. Fukushi, T. (1930)..... On the mosaic disease of broad bean. Jour. Pl. Prot., 18: 707–712, 779–784. (Abstr. R.A.M., 10: 700.)
9. Gigante, R. (1937)..... Il mosaico della Fava ('*Vicia faba* 'L.) in Italia e comportamento di alcune Leguminose di fronte ad esso. Boll. Staz. Pat. veg. Roma., 17: 497–529. (Abstr. R.A.M. 17: 645.)
10. Hagedorn, D. J. & Walker, J. C. (1949). Wisconsin pea streak. Phytopathology, 39: 837–847.
11. Imai, Y. (1934)..... Studies on the transmission of broad bean mosaic. Trans. Sapporo Nat. Hist. Soc., 13: 241–245. (Abstr. R.A.M., 14: 4).

12. JOHNSON, F. (1942)..... The complex nature of white clover mosaic. Phytopathology, 32: 103–116.

13. MERKEL, L. (1929)..... Beiträge zur Kenntnis der Mosaikkrankheit der Familie der Papilionacee. Zeitschr. Pflanzenkr. u. Pflanzensch., 39: 289-347.

14. MURAYAMA, D. (1938)..... Physico-chemical properties of the virus of broad bean mosaic. Jour. Fac. Agric. Hokkaido Univ., 44: 1–32 (Abstr. R.A.M., 18: 224).

15. OSBORN, H. T. (1937)..... Studies on the transmission of pea virus 2 by aphids. Phytopathology, 27: 589–603.

16. PIERCE, W. H. (1935)..... The identification of certain viruses affecting leguminous plants. Jour. Agric. Res., 51: 1,017–1,039.

17. QUANTZ, L. (1953)..... Untersuchungen über ein samenübertragbares Mosaikvirus der Ackerbohne (*Vicia faba*) Phytopath. Zeitschr., 20: 420–448.

18. RUBIO, M. AND VAN SLOGTEREN, D. H. M. (1956) Light and electron microscopy of X- bodies associated with broad bean mottle virus and *Phaseolus* virus 2. Phytopathology, 46: 401–402.

19. SEVERIN, H. H. P. AND HENDERSON, C. F. (1928) Some host plants of curly top. Hilgardia, 3: 339–393, 595–636.

20. STUBBS, L. L. (1947)..... A destructive vascular wilt virus disease of broad bean (*Vicia faba* L.) in Victoria. Jour. Dept. Agric. Vict. Austr., 45: 323–332.

21. VAN DER MEULEN, J. G. J. (1928).. Voorlopige onderzoek naar de specialisatie en die infectiebronnen der mozaiekziekten van landbougewassen. Tijdschr. Plantenz., 34: 151–176.

22. WEISS, F. (1945)..... Viruses described primarily on leguminous vegetable and forage crops. Pl. Dis. Reptr. Suppl. 154.

23. WELLMAN, F. L. (1934)..... Identification of celery virus 1. The cause of southern celery mosaic. Phytopathology, 24: 695–725.

24. WINGARD, S. A. (1928)..... Hosts and symptoms of ringspot: a virus disease of plants. Jour. Agric. Res., 37: 127–153.

25. YU, T. F. (1939)..... Mild-mosaic virus of broad bean. Phytopathology, 29: 448–455.

26. ———— (1939)..... A suspected virosis of the severe leaf-curl or stunt type occurs in China near Nanking. Phytopathology, 29: 459–461.

27. ———— (1947)..... Spotted wilt of broad bean. Phytopathology (Note), 37: 191–192.

28. ZAUMEYER, W. J. (1937)..... Pea streak and its relationship to strains of alfalfa mosaic. Phytopathology, 27: 144.

29. ———————— (1938)..... A streak disease of peas and its relation to several strains of alfalfa mosaic virus. Jour. Agric. Res., 56: 747–772.

30. ———————— (1940)..... Three previously undescribed mosaic diseases of pea. Jour. Agric. Res., 60: 433–452.

31. ZAUMEYER, W. J. AND WADE, B. L. (1935) The relationship of certain legume mosaics to bean. Jour. Agric. Res., 51: 715–749.

32. ZAUMEYER, W. J. AND WADE, B. L. (1936) Pea mosaic and its relation to other legume mosaic viruses. Journ. Agric. Res., 53: 161–185.

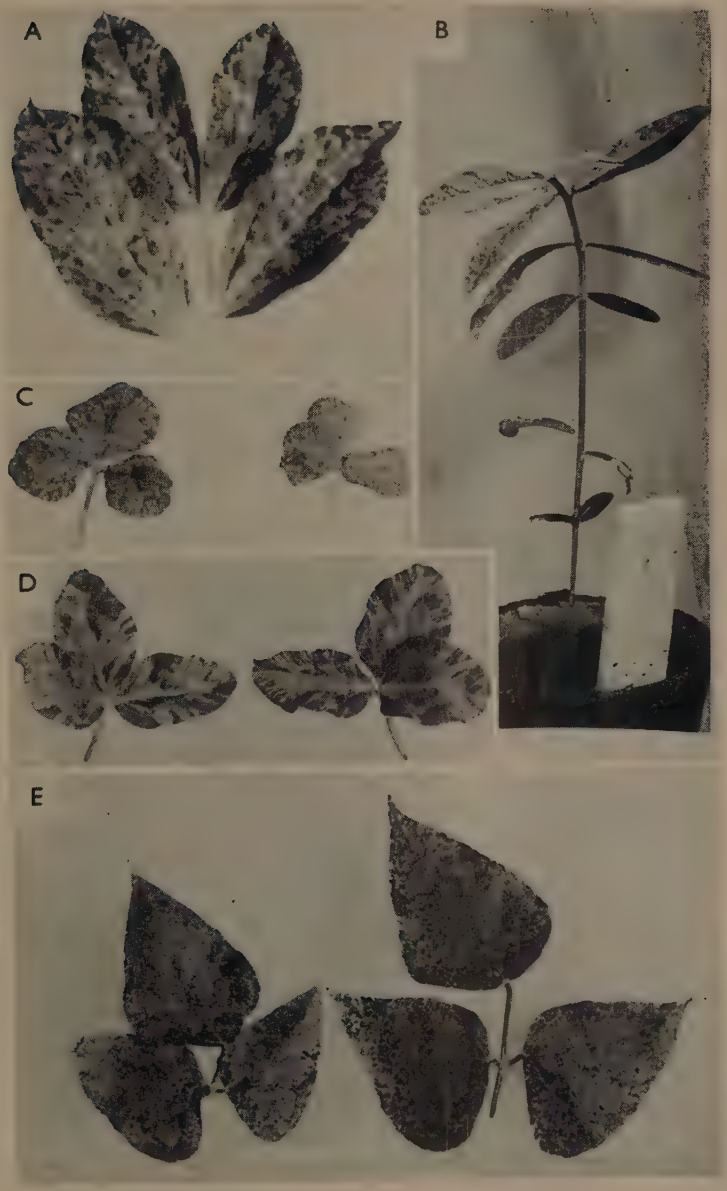

FIG. 1.—BROAD BEAN MOSAIC VIRUS A.

A. *Vicia faba*—showing depressed chlorotic areas. B. *Crotalaria juncea*. C. *Trifolium incarnatum*. D. *Trifolium pratense*. E. *Phaseolus lunatus*.

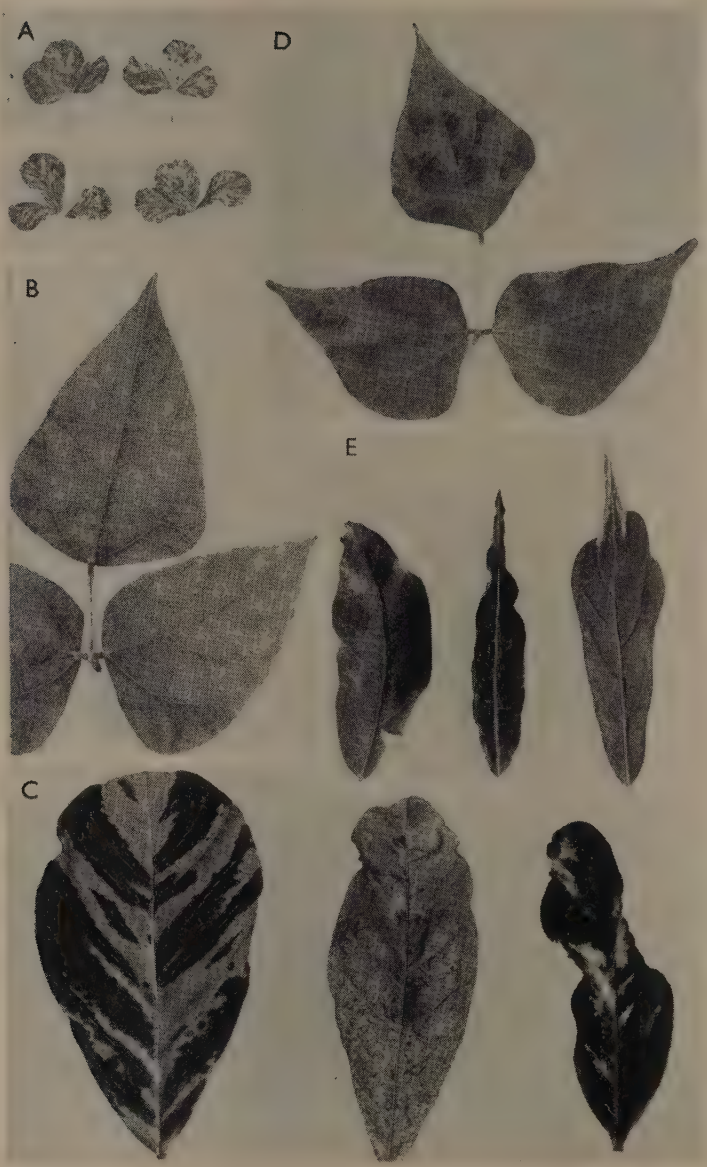

FIG. 2.—BROAD BEAN MOSAIC VIRUS B.

A. *Trifolium incarnatum*. B. *Phaseolus lunatus*. C. *Crotalaria spectabilis*. D. *Phaseolus vulgaris*. E. *Crotalaria juncea*.

Chromosome Morphology in Kniphofia.

By

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ABSTRACT.

A number of species and varieties of the genus *Kniphofia* (Liliaceae) were studied cytologically. The somatic chromosome number is $2n = 12$ in all the species. This is also true in *Notosceptrum natalense* Baker.

MATERIAL AND METHODS.

The material studied was collected in the veld and cultivated on the Prinshof Experiment Station in Pretoria. The collectors' numbers listed in Table 1 also refer to the specimens filed with the National Herbarium, Pretoria. Root-tips were fixed in Randolph's (1935) fluid, dehydrated using normal butyl alcohol and embedded in a paraffin-beeswax-rubber mixture. Sections were stained in Stockwell's (1934) fluid. Inflorescences were fixed in 3: 1 absolute ethyl alcohol, propionic acid. Anthers were squashed in propionic-carmine after the method outlined by Swaminathan, Magoon and Mehra (1954). Karyotypes were computed with the aid of a camera lucida, using the average length of chromosomes from five different metaphase plates. The magnification is X2,500.

CHROMOSOME NUMBER.

The genus was previously studied by Webber (1932), Moffet (1932) and Janaki-Ammal (1950), demonstrating $n = 6$. Polyploidy appears to be absent except in a triploid specimen of *K. snowdenii* from Uganda (Janaki-Ammal, 1950). The species studied are listed in Table 1. Polyploid cells were observed in otherwise normal diploid roots of *K.* sp. (Codd 6955). This is also true among pollen mother cells of this species. In these cells quadrivalents, together with a varying number of bivalent and univalents, were observed. Similar observations were made by Moffet (1932) in polyploid cells of *K. triangularis* (= *K. nelsonii*). In the diploid pollen mother cells, chromosome pairing and movement are normal.

CHROMOSOME MORPHOLOGY.

The haploid chromosome set of $n = 6$ in *Kniphofia* may be subdivided into three distinct groups. Two chromosomes are significantly longer than the rest. Both are characterized by secondary constrictions. They differ from each other in the position of the centromere.

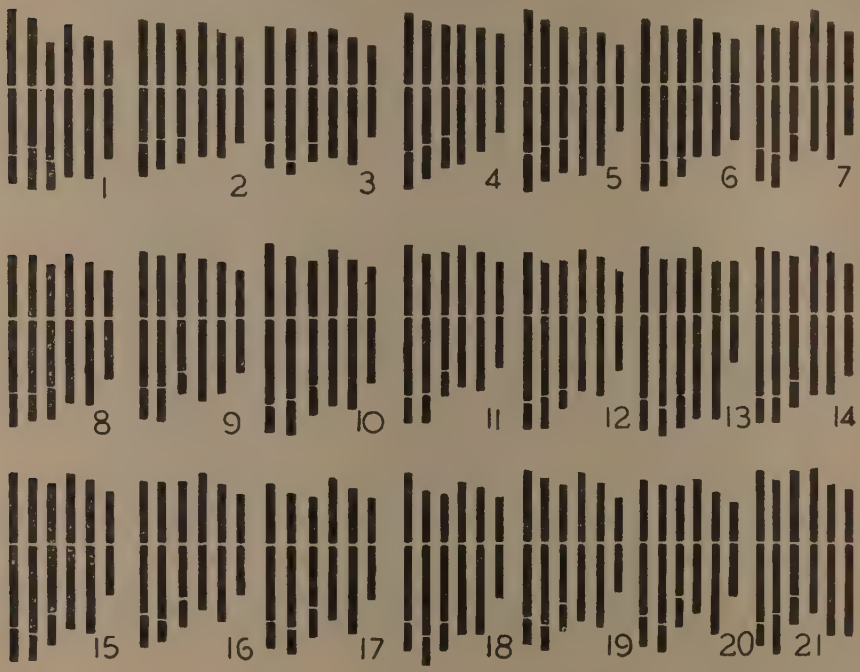
Three chromosomes are of medium length. One of these is characterized by a secondary constriction, whereas the other two differ from each other in the position of the centromere. The sixth chromosome is short with a submedian centromere.

The material of *Notosceptrum* resembles *Kniphofia* in karyotype except for the sixth chromosome which is also of medium length. The karyotype varies very little from one species of *Kniphofia* to the other.

During meiotic telophase six nucleoli are always produced. This indicates the presence of six chromosomes with nucleoli organizing regions (Pathak, 1940, Gates, 1942, de Wet, 1953). These are evidently the six chromosomes (three chromosome pairs) with secondary constrictions.

TABLE 1.—*Chromosome numbers in* Kniphofia *and* Notosceptrum.

Name.	Origin.	Collector.	2n	Fig.
Kniphofia—				
K. baurii Bak.	Newcastle.	Codd 6509.	12	1
K. bachmanii Bak.	S.W. Cape.	van Breda s.n.	12	2
K. caulescens Bak.	Nottingham Rd.	Smuts s.n.	12	3
K. ensifolia Bak.	Linokana.	Bruce 231.	12	4
(=K. rivularis Berger).	Pretoria.	Codd 4777.	12	
K. ensifolia Bak. var. albiflora E. A. Bruce.	Kransberg.	Bruce 56.	12	5
K. ichopensis Schinz.	Tabamhlope.	Killick s.n.	12	6
K. macowanii Bak.	Wuthering Heights.	Codd 8530.	12	7
K. multiflora Bak.	Wonderhoogte.	Codd s.n.	12	8
K. obtusiloba Diels ex Berger.	Slaaihoek.	Codd 8274.	12	9
K. porphyrantha Bak.	Belfast.	Codd 7592.	12	10
(= K. conrathii Bak.).	Pretoria.	Codd 4776.	12	
K. sp.	Cathedral Peak.	Killick 1466.	12	11
K. praecox Bak.	E. Cape.	Bruce 522.	12	12
K. rhodesiana Rendle.	Mariepskop.	Codd 7922.	12	13
K. rooperi (Moore) Lem.	Sunwich Port.	Codd 6793.	12	14
K. rufa Bak.	Cathedral Peak.	Killick 1467.	12	15
K. rigidifolia E. A. Bruce.	Machadodorp.	Codd 8066.	12	16
K. splendida E. A. Bruce.	Magoebaskloof.	Groeneveld s.n.	12	17
K. tysonii Bak.	Rosetta.	Codd 8520.	12	18
K. tuckii Bak.	Fauresmith.	Henrici s.n.	12	19
K. uvaria (L.) Hook.	Stormsvlei.	van Breda s.n.	12	20
Notosceptrum—				
N. natalense Bak.	Potchefstroom.	de Wet 392.	12	21



DISCUSSION.

Polyploidy is absent in the South African species of *Kniphofia*. The presence of polyploid cells in otherwise normal diploid species could give rise to viable pollen with variable chromosome numbers. These could produce individuals such as the triploid specimen of *K. snowdenii* from Uganda. Although more than 50 collections of various species of *Kniphofia* from all over the Union were studied no abnormal chromosome numbers were encountered.

Species evolution in Kniphofia must have taken place through point mutations and small chromosomal aberrations. This perhaps is also the reason why many collections are difficult to classify with certainty into specific units. The specific characters could become established in the newly evolved individuals through isolating mechanisms such as flowering time and geographical distribution. When the species are planted together they hybridize freely.

References.

de Wet, J. M. J. (1953). Cytologia 18: 229–234 (1953).
Gates, R. R. Jour. Linn. Soc. Lond. 51: 7–9 (1940).
Janaki-Ammal, E. K. Jour. Roy. Hort. Soc. 75: 23 (1950).
Moffet, A. A. Jour. Gen. 25: 315 (1932).
Pathak, G. N. Jour. Gen. 39: 437–467 (1940).
Randolph, L. F. Stain Techn. 10: 95–96 (1935).
Stockwell, P. Science 80: 121–122 (1934).
Swaminathan, M. S., M. L. Magoon and K. L. Mehra. Indian Jour. Genet. Plant Breed. 14: 87–88 (1954).
Webber, J. M. Amer. Jour. Bot. 19: 411 (1932).

Leaf Anatomy of Six South African Grass Genera.

By

J. M. J. de Wet.

The significance of leaf anatomy in grass taxonomy was demonstrated by Duval-Jouve (1875), Pee-Laby (1898), Avdulov (1931) and Prat (1936). This paper deals with the genera *Entoplocamia* Stapf, *Fingerhuthia* Nees, *Lasiochloa* Kunth., *Plagiochloa* Adamson and Sprague, *Tetrachne* Nees and *Urochlaena* Nees. They are usually included in the Festuceae but appear to occupy an aberrant position in this tribe. Recently, Chippindall (1955) referred *Fingerhuthia* Nees to the tribe Chlorideae and the remaining five genera to the tribe Eragrosteae. Anatomical data may provide clues as to the true relationships of these genera.

MATERIAL AND METHODS

The specimens investigated were made available by the National Herbarium, Pretoria. Anatomical slides were prepared as indicated by Prat (1948) and de Wet (1956). Root-tips were collected in the veld, fixed in Randolph's (1935) fluid, dehydrated using normal butyl alcohol as clearing agent and stained in Stockwell's (1934) solution.

RESULTS

Anatomical, morphological and cytological observations are presented in Table 1. The leaf anatomy of *Fingerhuthia* Nees was first studied by Prat (1936) who indicated that the genus is chloridoid in this respect. Moffet and Hurcombe (1949) demonstrated small chromosomes and $2n = 20$ for *Tetrachne dregei* Nees and de Wet (1958) reported small chromosomes in *Fingerhuthia africana* Lehm. ($2n = 40$) and *F. sesleriaeformis* Nees ($2n = 20$). The chromosomes of *Plagiochloa uniolae* (L.f.) Adamson and Sprague ($2n = 48$) were found to be larger than those of the other two genera. The remaining three genera are unknown cytologically. Morphological data, although varified, are borrowed from Stapf (1900), Phillips (1951) and Chippindall (1955). The genus *Plagiochloa* was recently removed from *Demazeria* Dum. by Adamson & Sprague (1941). This new genus is closely related to *Lasiochloa* Kunth. Chippindall (1955) indicates that their distribution is similar and although the extremes in each genus are clearly distinct, there are species in both that suggest possible hybridization between them.

Discussion

The characteristics of the main subdivisions of the Gramineae have been illustrated and discussed by Stebbins (1956). It is evident that the genera studied do not belong with the tribe Festuceae. This tribe is characterized by large chromosomes, mostly in multiples of $n = 7$, spherical siliceous cells in an epidermis that lacks bicellular hairs and the chlorophyll tissue of the leaf is uniformly distributed throughout in the

mesophyll between the vascular bundles. The genera *Entoplocamia* Stapf, *Fingerhuthia* Nees and *Tetrachne* Nees are chloridoid in all respects, except that the spikelets disarticulate below the glumes, but this characteristic is present in other typically chloridoid genera such as *Catalepis* Stapf and Stent and *Spartina* Schreb. For these reasons the classification of Chippindall (1955) who refers *Fingerhuthia* Nees to the Chlorideae and the other two genera to the Eragrosteae are justifiable. The genera *Lasiochloa* Kunth., *Plagiochloa* Adamson and Sprague and *Urochlaena* Nees, however, do not belong with either of the tribes Eragrosteae or Festuceae. Internal leaf anatomy is of the festucoid type and epidermal traits are pancicoid. The chromosomes of *Plagiochloa uniolae* Adamson and Sprague are larger than those of the panicoid group of grasses, but smaller than those of the festucoid group. In respect of anatomical traits, chromosome size and basic chromosome number these genera resemble members of the tribe Danthonieae. The rhachilla, however, disarticulates below the glumes, a character not present in members of the Danthonieae. These genera also resemble members of the Unioleae except for the relatively large chromosomes observed in *Plagiochloa uniolae* Adamson and Sprague.

Summary

Leaf anatomy was studied in six small South African grass genera. These data were correlated with cytology and spikelet morphology in an attempt to determine their phylogenetic position in the family Gramineae. The genera *Entoplocamia* Stapf, *Tetrachne* Nees and *Fingerhuthia* Nees are chloridoid in respect of leaf anatomy and spikelet morphology. Cytological data from the latter two genera point to a similar conclusion. *Lasiochloa* Kunth., *Urochlaena* Nees and *Plagiochloa* Adamson and Sprague are festucoid in respect of spikelet morphology and internal leaf anatomy, panicoid in respect of epidermal traits and the latter genus resemble members of the Danthonieae in respect of chromosome size and basic number.

Key based on Anatomical and morphological Characters.

1. Inner bundle sheath poorly differentiated, outer bundle sheath comprises a layer of large parenchymatous cells which contain chloroplasts, remaining chlorophyll tissue confined to a single layer of cells surrounding the vascular bundle; stomata rhomboid in shape, siliceous cells saddle-shaped, bicellular hairs club-shaped; chromosomes small, $n = 10$; embryo $\frac{1}{2}$–$\frac{3}{4}$ as long as the grain; rhachilla disarticulates below the glumes 2

   Inner bundle sheath well developed, outer bundle sheath comprises a layer of small parenchymatous cells which do not contain chloroplasts, chlorophyll uniformly distributed throughout the mesophyll between the bundles; stomata rhomboid in shape, siliceous cells dumbbell-shaped, bicellular hairs linear in shape; chromosomes relatively large, $n = 12$; grain enclosed by the lemma and palea; rhachilla disarticulates below the glumes; flowers all bisexual or the uppermost gradually reduced 4

2. Lower florets all bisexual, uppermost lemma subtending a male flower or empty; grain not enclosed by the lemma and palea, lodicules 2, cuneate, fleshy, nerved ..... *Fingerhuthia*

   Lower lemmas empty florets aborted, upper bisexual, uppermost subtending a male flower or palea only; grain loosely enclosed by the lemma and palea 3

3. Lodicules absent ..... *Entoplocamia.*

   Lodicules 2, cuneate, fleshy ..... *Tetrachne.*

4. Embryo large, $\frac{1}{2}$ the length of the grain; lodicules 2, minute ..... *Urochlaena.*

   Embryo small, less than $\frac{1}{2}$ the length of the grain; lodicules 2, cuneate, ciliate .. 5

5. Spikelets 3–9-flowered, placed obliquely to the central axis ..... *Plagiochloa.*

   Spikelets 2–3-flowered, not placed obliquely to the central axis ..... *Lasiochloa.*

LITERATURE CITED

Adamson, R. S. and T. A. Sprague The genus *Plagiochloa.* Jour. So. Afr. Bot. 7: 89–92. (1941)

Avdulov, N. P. (1931) ..... Karyo-systematische Untersuchung der Familie Gramineen. Bull. App. Bot. Plant Breed. Suppl. 44: 1–428.

CHIPPINDALL, L. K. A. (1955)..... The classification of grasses. The grasses and pastures of South Africa: 1–527.

DE WET, J. M. J. (1956)..... Leaf anatomy and phylogeny in the tribe Danthonieae. Amer. Jour. Bot. 43: 175–182.

———————— (1958)..... Additional chromosome numbers in Transvaal grasses. Cytologia 23: in press.

DUVAL-JOUVE, M. J. (1875)..... Histotaxie des feuilles de Graminees. Ann. Sci. Nat. Bot. XIV. 1: 294–371.

MOFFET, A. A. AND R. HURCOMBE, (1949) Chromosome numbers of South African grasses. Heredity 3: 369–374.

PEE-LABY, E. (1898)..... Etude anatomique de la Feuille des Graminees de la France. Ann. Sci. Nat. Bot. VIII. 8: 227–346.

PHILLIPS, E. P. (1951)..... The genera of South African flowering plants. Bot. Survey So. Afr. Mem. 25: 58–148.

PRAT, H. (1936)..... La systematique des Graminees. Ann. Sci. Nat. Bot. X. 18: 165–258.

———— (1948)..... General features of the epidermis in *Zea mays*. Ann. Missouri Bot. Gard. 35: 341–351.

RANDOLPH, L. F. (1935)..... A new fixing fluid and a revised schedule for the paraffin method in plant cytology. Stain Techn. 10: 95–96.

STAPF, O. (1900)..... Gramineae. Flora Capensis 7: 310–750.

STEBBINS, G. L. (1956)..... Cytogenetics and evolution of the grass family. Amer. Jour. Bot. 43: 890–905.

STOCKWELL, P. (1934)..... A stain for difficult plant material. Science 80: 121–122.

Leaf Anatomy and Morphology in South African Species of Danthonia.

By

J. M. J. de Wet. *

The genus *Danthonia* is variable and this is particularly true of the South African species (de Wet, 1954a and 1956). On the basis of anatomical and morphological evidence Nevski (1934)† removed *D. glauca* Nees and *D. forskalii* (Vahl.) R. Br. from *Danthonia* to form the basis of a new genus, *Asthenatherum.* It was suggested by Hubbard (1937) that some other South African species may be equally worthy of generic rank. A new genus *Alloeochaete* was described by Hubbard (1940) to include *D. andongensis* Rendle. The South African species were studied in detail in order to determine whether any other species should be removed from *Danthonia.*

MATERIAL AND METHODS

Anatomical slides were prepared from Herbarium material as indicated by Prat (1948) and de Wet (1956). Chromosome numbers were counted in root-tip sections. Root-tips were collected in the veld, fixed in Randolph's (1935) fluid, dehydrated and sectioned as indicated by de Wet (1953) and stained in Stockwell's (1934) solution. Drawings of chromosomes and vascular bundles were made with the aid of a camera lucida.

RESULTS

The anatomical study is confined to mature leaves. These data are presented in the form of a key in Table 1. Only the lower epidermis surface has been studied. In *D. forskalii* (Vahl.) R. Br. the siliceous cells are in the shape of short dumbbells which often appear spherical.

Table 1.—ANATOMICAL TRAITS

1.	Chlorophyll localized around the vascular bundles; inner bundle sheath sclerenchymatous, outer bundle sheath parenchymatous; bicellular hairs present; siliceous cells dumbbell-shaped, localized above nerves; unicellular hairs form an arch over stomata. (Figs. 2 and 5).....	*D. forskalii, D. glauca, D. mossamedensis, D. suffrutescens.*
	Chlorophyll not localized around the vascular bundles.....	2
2.	Chlorophyll uniformly distributed throughout the mesophyll of the leaf (Fig. 3)..	3
	Chlorophyll not uniformly distributed throughtout the mesophyll of the leaf....	4
3.	Inner bundle sheath sclerenchymatous.....	5
	Inner bundle sheath colenchymatous.....	6
5.	Outer bundle sheath composed of thin parenchyma; bicellular hairs present....	7
	Outer bundle sheath composed of thick parenchyma; bicellular hairs absent....	8

* For reading the manuscript and for his valuable suggestions, the author wishes to thank Dr. G. L. Stebbins.

† Ex, Hubbard (1937), page 135.

7. Unicellular hairs do not form an arch over the stomata 9
Unicellular hairs form an arch over the stomata 10

9. Epidermis cells thin parenchyma; dumbbell-shaped siliceous cells localized above the nerves (Fig. 6). *D. brachyphylla, D. curva, D. macrantha, D. purpurea, D. tenella.*
Epidermis cells thick parenchyma; spherical siliceous cells localized above the nerves (Fig. 7) ..... *D. dura, D. stricta.*

10. Epidermis cells thick parenchyma; dumbbell-shaped siliceous cells localized above nerves ..... *D. pumila.*

8. Epidermis cells thick parenchyma; halfmoon-shaped siliceous cells distributed all over the epidermis ..... *D. cincta, D. papposa.*

6. Outer bundle sheath composed of thin parenchyma 11
Outer bundle sheath composed of thick parenchyma 12

11. Epidermis cells thin parenchyma; bicellular hairs absent; siliceous cells, spherical, localized above nerves ..... *D. lanata, D. lupulina.*
Epidermis cells thick parenchyma; bicellular hairs absent; siliceous cells spherical, distributed all over the epidermis ..... *D. arundinacea.*

12. Phloem divided into two groups by sclerenchymatous cells 13
Phloem in one group 14

13. Epidermis cells thin parenchyma; bicellular hairs absent, siliceous cells spherical, localized above nerves ..... *D. zeyheriana, D. zeyheriana* var. *trichostachya.*
Epidermis cells thick parenchyma; bicellular hairs absent; siliceous cells spherical, distributed all over the epidermis ..... *D. drakensbergensis, D. macowanii.*

14. Epidermis cells thick parenchyma; bicellular hairs absent, siliceous cells spherical, distributed all over the epidermis (Fig. 8) ..... *D. disticha.*

4. Leaves more or less spherical; chlorophyll localized in a continuous band 3–5 layers of cells thick directly below the epidermis; mesophyll in the middle lacks chloroplasts; inner bundle sheath sclerenchymatous, outer bundle sheath composed of thin parenchyma (Fig. 1); bicellular hairs absent; epidermis cells thick parenchyma; siliceous cells spherical, localized above nerves ..... *D. rangei.*

The morphology of the South African species of *Danthonia* has been discussed by Stapf (1900), Hubbard (1937) and Chippindall (1955). It will suffice to discuss the main characteristics of each group into which *Danthonia* was subdivided on the basis of anatomical traits. The species *D. mossamedensis* Rendle and *D. suffrutescens* Stapf share with *Asthenatherum* (*D. glauca* Nees and *D. forskalii* (Vahl.) R. Br.) the following prominent characteristics of external morphology. The lower culms are shortly pubescent to tomentose; innovation shoots are extravaginal; glumes strongly chartaceous, the lower distinctly 7–11–nerves and the upper 5–9–nerved; lemmas 7–10–nerved with the hairs arranged in rows between the nerves, the outer rows ending in tufts of longer hairs just below the lobes and the inner rows ending just below the insertion of the awn; lodicules 2, cuneate, nerved and glabrous; callus acute. These characteristics are also descriptive of *D. pumila* Nees, except that in the latter species the callus is obtuse. *Danthonia glauca* Nees and *D. suffrutescens* Stapf resemble each other so closely that the latter species could perhaps be regarded as a variety of *D. glauca* Nees. As indicated by Stapf (1900) they differ from each other only in two characters. The spikelets of *D. suffrutescens* Stapf are slightly larger and more acuminate than those of *D. glauca* Nees and the plant is suffrutescent with the lower sheath coriaceous. In contrast *D. glauca* Nees has smaller spikelets, is herbaceous and has a thin lower sheath. The genus *Asthenatherum* is further characterized by the panicoid type of internal leaf anatomy and epidermis.

The typical *Danthonia* species with dumbbell-shaped siliceous cells may be subdivided into three groups on the basis of external morphological traits. *Danthonia macrantha* Schrad. and *D. brachyphylla* Nees resemble *Pentameris* in superficial appearance but are more typical of *Danthonia* in spikelet morphology (Chippindall, 1955). They differ from other species of *Danthonia* conspicuously only in having two florets per spikelet and in that the hairs of the stigma bend down to join over the top of the ovary.

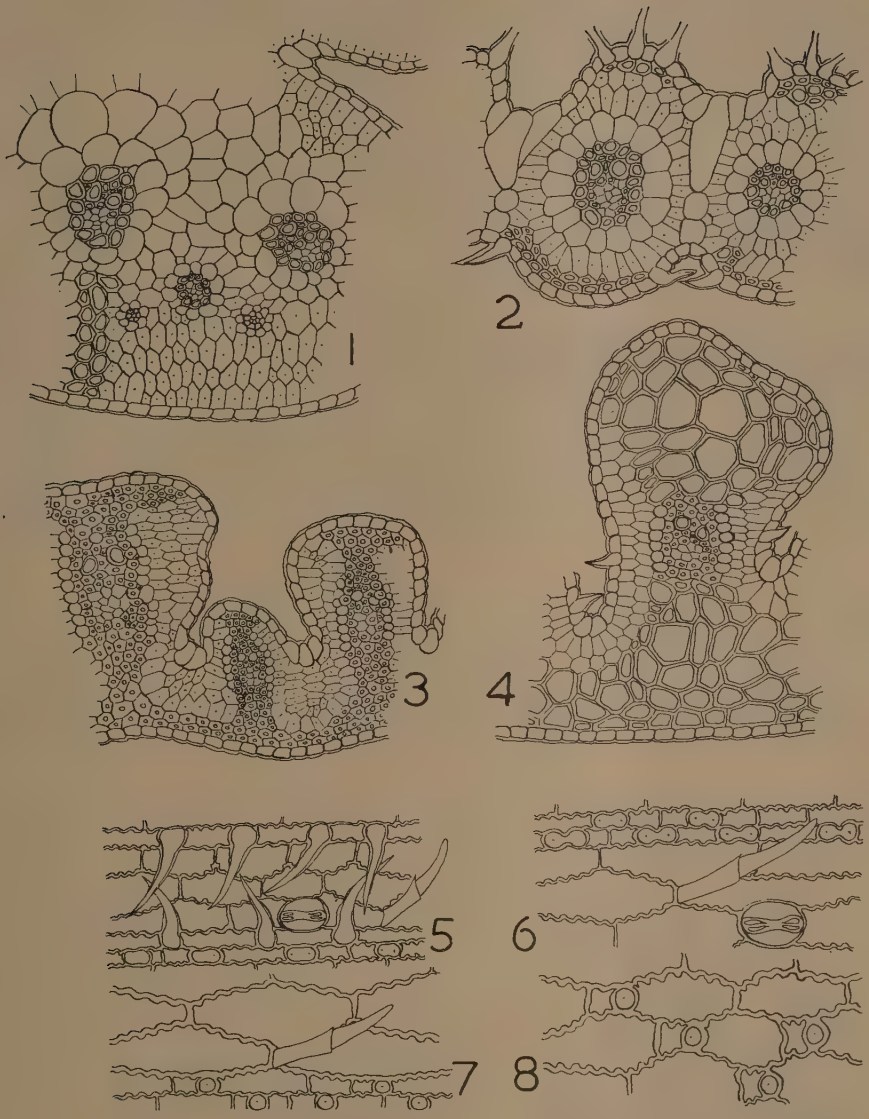


FIG. 1–4.—Internal leaf anatomy × 750. 1. *D. rangei;* 2. *D. forskalii;* 3. *D. arundinacea;* 4. *D. cincta.*

FIG. 5–6.—Epidermis × 1000. 5. *D. forskalii;* 6. *D. curva;* 7. *D. stricta;* 8. *D. disticha.*

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Glumes that are 5-nerved; 9-nerved lemmas with a transverse fringe of tufts of long hairs below the insertion of the awn and several submarginal tufts below this fringe; distinctly 3-nerved lemma-lobes and 2 lodicules which are small, cuneate-obovate and ciliate are characteristic of *D. purpurea* Beauv. and the closely related annual *D. tenella* Nees.

Danthonia curva Nees with dumbbell shaped siliceous cells resemble *D. lanata* Schrad., *D. lupulina* (Thunb.) Roem. and Schult. and *D. zeyheriana* Steud. in spikelet morphology. These species have in common: glumes 3–5–nerved; lemmas 9–nerved with the hairs arranged in rows between the nerves ending just below the middle in a transverse fringe of long hairs; lobes of the lemma partly adnate to the awn; lodicules 2, obovate, ciliate, nerved.

Danthonia cincta Nees and *D. papposa* Nees differ from all other species of *Danthonia* in having 1–3–nerved glumes. Anatomically they are also quite distinct from other species of *Danthonia* (Figure 4). The cells between the bundles are sclerenchymatous except for two or more layers of cells along grooves of the upper epidermis. The chloroplasts are localized in these layers of parenchymatous cells.

Morphologically *D. dura* Stapf *D. stricta* Schrad., *D. drakensbergensis* Schweick. and *D. macowani* Stapf form a natural group with the following salient features: glumes 3–5–nerved; lemmas 7–9–nerved, with the hairs variously tufted; lemma-lobes partially adnate to the awn; callus obtuse; lodicules 2, obovate, ciliated, nerved.

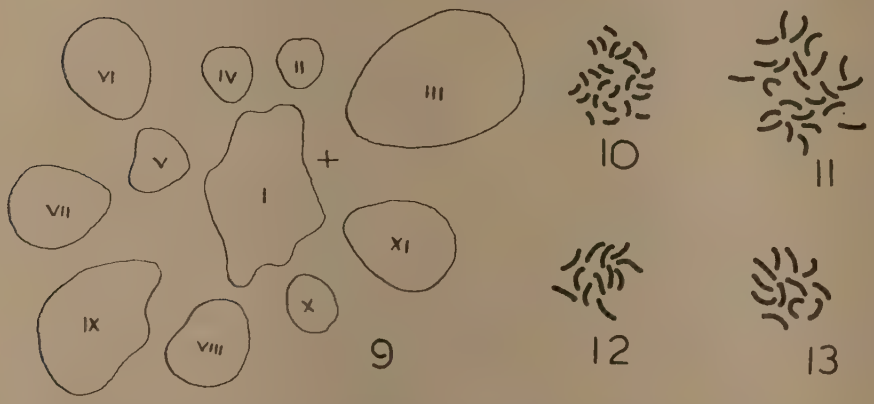


FIG. 9.—Diagram showing the relationships between species of *Danthonia*. The numbers represent groups of species as follows: Hypothetical ancestor; i. *D. curva*, *D. purpurea*, *D. tenella;* ii. *D. pumila;* iii. *Asthenatherum* (*D. forskalii*, *D. glauca*, *D. mossamedensis*, *D. suffrutescens*); iv. *D. rangei;* v. *D. arundinacea;* vi. *D. cincta*, *D. papposa;* vii. *D. lanata*, *D. lupulina;* viii. *D. dura*, *D. stricta;* ix. *D. drakensbergensis*, *D. macowanii*, *D. zeyheriana;* x. *D. disticha*, xi. *D. brachyphylla*, *D. macrantha*.

FIG. 10–11.—Chromosome numbers × 3000. 10. *D. forskalii*, 11. *D. tenella;* 12. *D. arundinacea;* 13. *D. macowanii*.

Danthonia arundinacea (Berg.) Schweick. is a robust, tufted perennial with stout culms from 80 cm to more than 100 cm high; glumes 1–nerved; lemmas 7–9–nerved, villous all over and the lobes taper into a fine, short awn. *Danthonia disticha* Nees differs from all other species of *Danthonia* in having the inflorescense shaped into a distichous spike. An analysis of the spikelet reveals typical *Danthonia* characteristics. Glumes 3–nerved, lemmas 9–11–nerved, bilobed, with the hairs arranged in a tuft at the base and with a line of similar hairs on each side extending to the base of the lobes; lodicules 2, obovate, ciliated, nerved.

Danthonia rangei Pilger with its peculiar internal leaf anatomy resembles *Asthenatherum* in habit and superficial appearance. Spikelet morphology, however, is more typical of *Danthonia*, except that the florets are reduced to 2 per spikelet. Glumes are 3–nerved; lemmas 5–7–nerved, hairy all over, with three tufts of hairs, one each at the base of the lobes and the third at the insertion of the awn; lodicules 2, cuneate, minute; callus obtuse.

Three species, *D. macowanii* Stapf ($2n = 12$), *D. arundinacea* (Berg.) Schweick. ($2n = 12$) and *D. tenella* Nees ($2n = 24$), were studied for the first time cytologically. A number of other species were previously studied by Calder (1937), Stebbins and Love (1941) and de Wet (1954 b). Basic chromosome numbers appear to be $n = 6$ and $n = 7$. It was also indicated by de Wet (1954b) that the chromosomes of species belonging to *Asthenatherum* [*D. forskalii* (Vahl.) R. Br.] are smaller than those of more typical members of *Danthonia* (compare Figures 10–11).

DISCUSSION.

The trends of evolutionary progress in the family Gramineae were pointed out by Stebbins (1956). From this discussion it becomes evident that the complex panicoid-eragrostoid type of epidermal traits (siliceous cells variously shaped, bicellular hairs present) and the festucoid type of chlorophyll distribution (uniformly distributed throughout the mesophyll of the leaf), are the more primitive leaf anatomical characters. Members of the genus *Danthonia* exhibit a combination of primitive and advanced anatomical traits.

The known diploid species are confined to southern Africa. On the basis of stomatal size it would appear as if these, *D. curva* Nees, *D. disticha* Nees, *D. arundinacea* (Berg.) Schweick. and *D. macowanii* Stapf, are the only diploid representatives of the genus. The stomata of these species vary in size from 23–30 μ to 25·00 μ. Other species with relatively small stomata are present in South America: *D. lechleri* Steud. (26·40 μ) and *D. secundiflora* Presl. (27·60 μ), but they resemble in stomatal size the known tetraploid species *D. tenella* Nees (26–30 μ) and *D. purpurea* Beauv. (26·40 μ) more closely (de Wet, 1954b).

The known diploids exhibit the primitive type of chlorophyll distribution. The epidermis is of the primitive type in *D. curva* Nees, but more advanced (bicellular hairs are absent and the siliceous cells are spherical) in the remaining three diploids. The lemma-lobes are well developed in these diploids, with the lemmas hairy all over in *D. arundinacea* (Berg.) Schweick. and variously tufted and fringed in the others.

In respect of spikelet morphology the North American species, together with some from South America and the European species, *D. calycina* Roem. and Schult., appear to be the most primitive. These are characterized by relatively poorly developed lemma-lobes and lemmas are hairy along the margins only, or also sparsely so on the back. The North American species with these characteristics are hexaploids ($2n = 36$) according to Stebbins & Love (1941). South American species which exhibit these primitive floral characteristics: *D. chilensis* Desv. has $2n = 36$, *D. oresigena* Phil.

has $2n = 48$, *D. cirrata* Hack. and Arech. has $2n = 72$ and the remaining species *D. malacantha* (Steud) Pilger, *D. montana* Doell., *D. montevidensis* Hack. and Arech., *D. secundiflora* Presl. and *D. tandilensis* Kotze are unknown cytologically. All these presumed primitive species are characterized by an epidermis with dumbbell-shaped siliceous cells and linear bicellular hairs. The chlorophyll is uniformly distributed throughout the mesophyll of the leaf and the outer bundle sheath is parenchymatous.

From this discussion it would appear as if the most primitive characters exhibited by present day species of *Danthonia* are as follows: Lemma-lobes poorly developed; hairs on the lemma not tufted or fringed and confined to the margins and the back; inner bundle sheath of the vascular bundles of the leaf sclerenchymatous, outer bundle sheath composed of parenchymatous cells; chlorophyll uniformly distributed throughout the mesophyll of the leaf; epidermis with dumbbell-shaped siliceous cells and linear bicellular hairs. No South African species exhibit all of these assumed primitive characters.

Two dominant lines of phylogenetic specialization are evident in the South African species of *Danthonia*. The first line gave rise to the genus *Asthenatherum*. The latter genus is regarded in this discussion to include the following species: *D. forskalii* (Vahl.) R. Br., *D. glauca* Nees, *D. mossamedensis* Rendle and *D. suffrutescens* Stapf. Morphologically they resemble the more typical species of *Danthonia* in many respects (Hubbard, 1937). Anatomically they retained the primitive epidermal characters but became specialized in respect of chlorophyll distribution. Only one of these species, *D. forskalii* (Vahl.) R. Br. is known cytologically, but it has been pointed out by de Wet (1954b) that although the basic chromosome number is, as in *Danthonia*, $n = 6$ or 12 the chromosomes are significantly smaller than those of typical representatives of *Danthonia*. It is of interest to note that all the species here included in *Asthenatherum* are adapted to grow exclusively in dry sandy areas. The second line of phylogenetic development retain the primitive type of chlorophyll distribution, but the outer bundle sheath became sclerenchymatous, bicellular hairs are absent from the epidermis and the siliceous cells are spherical. This group includes the species *D. disticha* Nees, *D. drakensbergensis* Schweick., *D., macowanii* Stapf and *D. zeyheriana* Steud. Three more species, *D. lanata* Schrad., *D. lupulina* (Thunb.) Roem. and Schult., and *D. arundinacea* (Berg.) Schweick., resemble the above species in leaf anatomical characters except that the outer bundle sheath is parenchymatous.

Danthonia stricta Schrad. and *D. dura* Stapf combine in their epidermis a peculiar combination of primitive and advanced characters. The siliceous cells are spherical, but linear bicellular hairs are always present.

Three species with the festucoid type of epidermal traits appear to represent specialized lines of development in respect of internal leaf anatomy. The chlorophyll bearing tissue is localized but not as in the highly developed panicoid type. These are *D. rangei* Pilger on the one side and *D. cincta* Nees and *D. papposa* Nees on the other side.

Among the species which retained the primitive type of epidermal traits, *D. brachyphylla* Nees and *D. macrantha* Schrad. exhibit a reduction in the number of fertile florets to two per spikelet. In these species the glumes are much enlarged and could serve as a means of seed dispersal.

The relationships of the species groups into which *Danthonia* may be subdivided on the basis of leaf anatomical and morphological characters are indicated in Figure 9. The actual connections between the species will only be known after a complete cytogenetical study of the genus has been undertaken. For this reason the type of diagrammatic presentation discussed by Stebbins (1956) has been adopted.

The various theories about centre of origin and plant migration have been discussed by Cain (1944). Although the greatest concentration of species is found in the south western tip of Africa, it would appear as if the genus migrated from the North. The species *D. calycina* Roem. and Schult. from Eastern Europe was shown to have retained many primitive characters and could perhaps be regarded as a relic. The tropical African species are characterized by the primitive type of anatomical characters and could perhaps be regarded as relics which have adapted themselves to their mountain existence in a tropical climate.

Small colonies of one or more species are also localized along the mountain ranges of the summer rainfall areas of southern Africa with a greater concentration of species in the winter rainfall area. The genus *Asthenatherum* extends from south east Asia into North Africa and along the arid areas of the west coast to South Africa. The presence of a species like *D. pumila* Nees along the arid west coast of South Africa is difficult to explain. As was pointed out earlier, this species resembles *Asthenatherum* very closely except for chlorophyll distribution of the leaf. In this respect it appears to form a direct link between *Danthonia* and *Asthenatherum*. If this species were present in south eastern Asia or North Africa it could have been regarded as a left-over of the original *Asthenatherum* type. Its presence in South Africa could be explained in any one of many ways. The most obvious although unlikely explanation is that *Asthenatherum* originated in South Africa, with *D. pumila* Nees forming a direct link between *Danthonia* and *Asthenatherum*. It is also possible that *D. pumila* Nees represents such a link and migrated south with *Asthenatherum*. It could also be regarded as a specialized line of development from *Asthenatherum*. The latter statement is hardly likely because it is difficult to imagine that the advanced type of chlorophyll distribution should change back to the more primitive one, especially as there is no obvious advantage in such a process. Another possibility is that *D. pumila* Nees represents a hybrid between a species of *Asthenatherum* and *Danthonia* or some other closely related genus. To the author the most likely explanation appears to be that *D. pumila* Nees represents a specialized line of phylogenetic development which came about after *Danthonia* had reached South Africa. It would appear as if the genera *Danthonia* and *Asthenatherum* had their origin in a common ancestor. The latter genus, being better adapted to dry conditions migrated south along the arid regions of the west coast of Africa. *Danthonia* migrated along the mountain ranges of the tropics and subtropics to reach the winter rainfall area of southern Africa.

SUMMARY

Leaf anatomy and morphology of the South African species of *Danthonia* were studied in detail. These data were correlated to trace the relationships of species. The problem of what is primitive and what is advanced has been related to leaf anatomy. Species with a combination of the panicoid type of epidermis and the festucoid type of internal leaf anatomy appear to represent the more primitive types. The possible direction of migration of the South African species of *Danthonia* was discussed. The chromosome numbers of *D. macowanii* Stapf ($2n = 12$), *D. arundinacea* (Berg.) Schweick. ($2n = 12$) and *D. tenella* Nees ($2n = 24$) are reported for the first time. Three species, *D. mossamedensis* Rendle, *D. pumila* Nees and *D. suffrutescens* Stapf should be transferred to *Asthenatherum*. The latter species could be regarded as a variety of *A. glauca* (Nees) Nevski.

LITERATURE CITED

CAIN, S. A. (1944)..... Foundations of plant geography. Harper and Brothers, New York. 556 pp.

CALDER, W. J. (1937)..... A cytological study of some New Zealand species and varieties of *Danthonia*. Jour. Linn. Soc. London 51: 1–9.

CHIPPINDALL, L. K. A. (1955)..... The classification of grasses. Grasses and pastures of South Africa: 1–527.

DE WET, J. M. J. (1953)..... Nucleoli numbers in *Danthonia* polyploids. Cytologia 18: 229–234.

DE WET, J. M. J. (1954a)..... The genus *Danthonia* in grass phylogeny. Amer. Jour. Bot. 41: 204–211.

DE WET, J. M. J. (1945b)..... Stomatal size as a cytological criterion in *Danthonia*. Cytologia 19: 176–181.

DE WET, J. M. J. (1956)..... Leaf anatomy and phylogeny in the tribe Danthonieae. Amer. Jour. Bot. 43: 176–182.

HUBBARD, C. E. (1937)..... Graminea. Flora tropical Africa 10: 123–147.

HUBBARD, C. E. (1940)..... *Alloeochaete andongensis* (Rendle) C. E. Hubbard. Hook. Icon. Plant. 5: tab. 3418.

PRAT, H. 1948..... General features of the epidermis in *Zea mays*. Ann. Missouri Bot. Gard. 35: 341–351.

RANDOLPH, L. F. (1935)..... A new fixing fluid and a revised schedule for the paraffin method in plant cytology. Stain Tech. 10: 95–96.

STAPF, O. (1900)..... Gramineae. Flora Cap. 7: 310–750.

STEBBINS, G. L. (1956)..... Cytogenetics and evolution of the grass family. Amer. Jour. Bot. 43: 890–905.

AND R. M. LOVE, (1941)..... A cytological study of California forage grasses. Amer. Jour. Bot. 28: 371–382.

STOCKWELL, P. (1934)..... A stain for difficult plant material. Science 80: 121–122.

Culm Anatomy in Relation to Taxonomy.

By

J. M. J. de Wet.

The problem of phylogenetic relations is not always to be solved by a study o external characters only. This is particularly true in the family Gramineae. A survey of characters that are useful in the classification of the grasses is presented by Stebbins (1956). During an investigation of anatomical characters in *Danthonia* it was noted that those species which could be referred to *Asthenatherum* Nevski differ from typical representatives of *Danthonia* in culm anatomy. These two species-groups also differ from each other in leaf anatomy (de Wet, 1954). To test the taxonomic significance of this character, a representative group of grasses from different tribes were studied.

MATERIAL AND METHODS

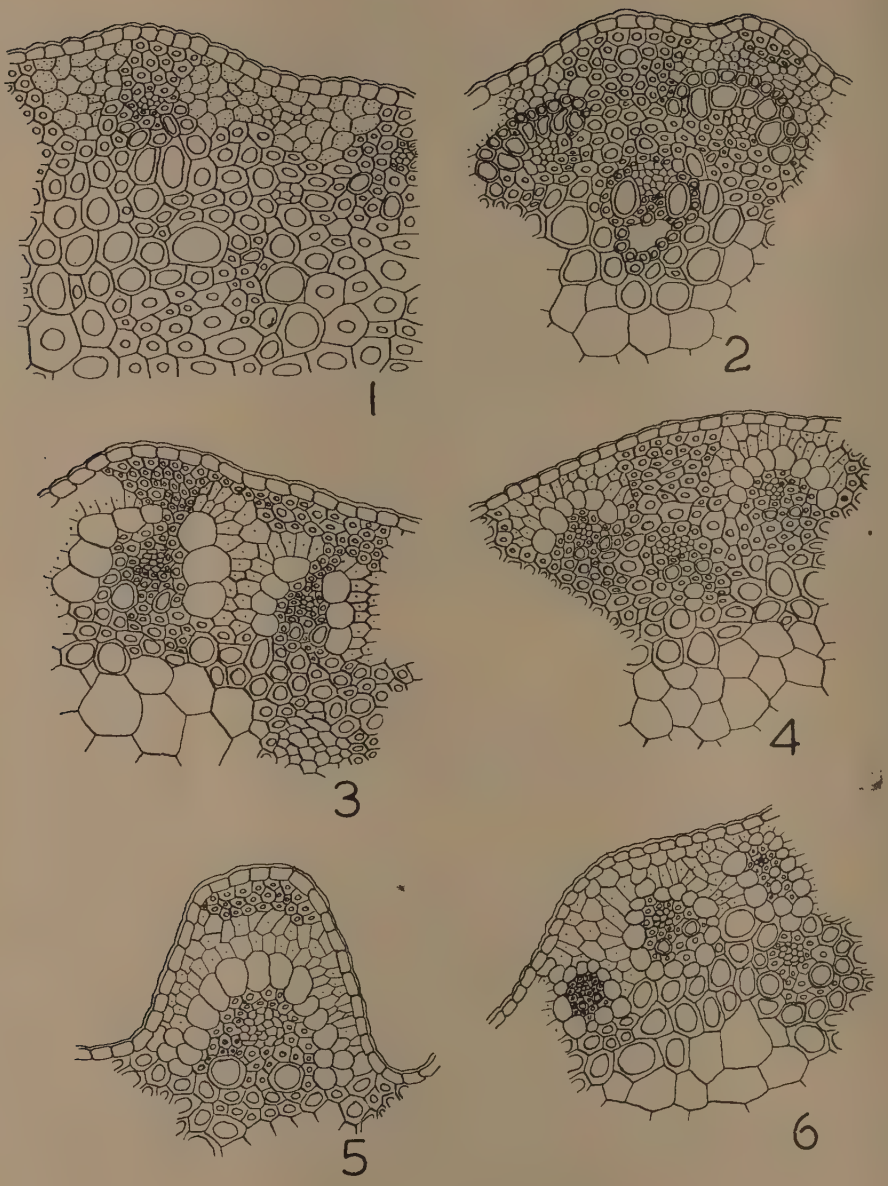
Specimens studied were obtained from the National Herbarium, Pretoria. Pieces of the culm taken just below the inflorescence were placed in a softening medium consisting of equal parts 50 per cent ethyl alcohol and glycerol for 24 hours. Sections were cut by hand and stained in a 1 per cent aquous safranine solution. Drawings were made with the aid of a camera lucida.

RESULTS

The genera studied are listed in Table 1. Two or more species of each genus were investigated. The concepts of tribes are similar to those of Avdulov (1931), Prat (1936) and Chippindall (1955). Leaf anatomical data are mostly from Avdulov (1931) and Prat (1936). The letters F (festucoid), E (eragrostoid-chloridoid), P (panicoid) and B (bambusoid) refer to the types of characters discussed and illustrated by Stebbins (1956).

Sections were cut transversely through the stem at about 1 cm below the inflorescence. Below the epidermis a more or less continuous circular layer of sclerenchyma and collenchyma is present, carrying bundles which are solitary or in pairs. Other bundles lay irregularly scattered in the pith. The bundles included by this circular sclerenchymatous strand are usually connected with the epidermis by a strand of collenchyma cells. The chlorenchyma is entirely situated between these strands and the epidermis. In other words, these small vascular bundles are always girdered by chlorenchyma cells. The layer of chlorenchyma cells directly bordering onto the vascular bundle usually distinguish themselves clearly by their size from the rest of the chlorenchyma. It is this layer of cells (bundle sheath) that appears to be of use in grass taxonomy.

In the festucoid group of grasses; tribes Festuceae, Brachypodieae, Hordeae, Aveneae, Phalarideae and Agrosteae this parenchymatous bundle sheath is poorly differentiated and can not be distinguished from the rest of the chlorenchymatous tissue (Fig. 1). This is also true in genera studied belonging to the tribes Oryzeae, Ehrharteae and Danthonieae (except for the genus *Asthenatherum*). This type of anatomical character was also observed in the genera *Lasiochloa*, *Plagiochloa* and *Urochlaena* which Chippindall (1955) refer to the tribe Eragrosteae.



In the eragrostoid-chloridoid group of grasses (Zoiseae, Eragrosteae, Chlorideae and Sporoboleae) the parenchymatous bundle sheath is composed of very large cells (Figs. 3 and 4). This bundle sheath is also obvious in the Paniceae, Arundinelleae

and the Andropogoneae (Figs. 5 and 6) but the individual cells are often not quite as large as is the case in the eragrostoid-chloridoid group. This is also true in representatives of the tribes Meliceae, Arundineae, Pappophoreae and the genus *Stipa*.

The genus *Aristida* is quite distinct from all the other grasses studied. A very obvious internal bundle sheath of sclerenchyma is present, surrounded by a parenchymatous sheath of smaller cells, which often are also thickened and apparently lack chlorophyll (Fig. 2).

TABLE 1.—Anatomical characteristics.*

Genus.	Culm anatomy.	Leaf anatomy.	Epid.
Oryzeae—			
Oryza	1	F	B
Potamophila	1	F	B
Ehrharteae—			
Ehrharta	1	F	B
Meliceae—			
Melica	2	F	P
Arundineae—			
Phragmites	2	P	P
Pappophoreae—			
Enneapogon	3	P	E
Schmidtia	2	P	E
Danthonieae—			
Asthenatherum	3	P	P
Chaetobromus	1	F	P
Danthonia	1	F	F–P
Pentameris	1	F	F
Pentaschistis	1	F	F–P
Poagrostis	1	F	P
Stipeae—			
Aristida	4	P	P–F
Stipa	2	F	F
Festuceae—			
Briza	1	F	F
Festuca	1	F	F
Poa	1	F	F
Vulpia	1	F	F
Brachypodieae—			
Brachypodium	1	F	F
Bromus	1	F	F
Hordeae—			
Elymus	1	F	F
Aveneae—			
Avena	1	F	F
Helictotrichon	1	F	F
Holcus	1	F	F
Koeleria	1	F	F
Phalarideae—			
Phalaris	1	F	F
Agrosteae—			
Agrostis	1	F	F
Calamagrostis	1	F	F
Zoiseae—			
Tragus	3	P	E
Mosdenia	3	P	E
Monelytrum	3	P	E
Perotis	3	P	E

* In culm anatomy: Type 1—parenchymatous sheath not obvious; type 2—sheath cells small; type 3—sheath cells extremely large; type 4—*Aristida*. In leaf anatomy and epidermis: F—festucoid; E—eragrostoid-chloridoid; P—panicoid; B-bambusoid types.

Genus.	Culm anatomy.	Leaf anatomy.	Epid.
Eragrosteae—			
Diplachne	3	P	E
Dinebra	3	P	E
Eragrostis	3	P	E
Entoplocamia	3	P	E
Lophacme	3	P	E
Leptocarydion	3	P	E
Lasiochloa	1	F	P
Odyssea	3	P	E
Plagiochloa	1	F	P
Pogonarthria	3	P	E
Stiburus	3	P	E
Tetrachne	3	P	E
Trichoneura	3	P	E
Triraphis	3	P	E
Tripogon	3	P	E
Urochlaena	1	F	P
Chlorideae—			
Cynodon	3	P	E
Chloris	3	P	E
Ctenium	3	P	E
Eustachys	3	P	E
Fingerhuthia	3	P	E
Harpechloa	3	P	E
Microchloa	3	P	E
Oropetium	3	P	E
Rendlia	3	P	E
Arundinelleae—			
Arundinella	2	P	P
Danthoniopsis	2	P	P
Loudetia	2	P	P
Tristachya	2	P	P
Trichopteryx	2	P	P
Paniceae—			
Anthephora	2	P	P
Alloteropsis	2	P	P
Acroceras	2	P	P
Brachiaria	3	P	P
Cenchrus	2	P	P
Digitaria	2	P	P
Eriochloa	2	P	P
Echinochloa	3	P	P
Melinis	2	P	P
Oplismenus	2	P	P
Panicum	2	P	P
Paspalum	2	P	P
Rhynchelytrum	2	P	P
Setaria	2	P	P
Tricholaena	2	P	P
Urochloa	2	P	P
Andropogoneae—			
Andropogon	2	P	P
Bothriochloa	2	P	P
Chrysopogon	2	P	P
Dichomis	2	P	P
Elyonurus	2	P	P
Hyparrhenia	2	P	P
Heteropogon	2	P	P
Hemarthria	2	P	P
Ischaemum	2	P	P
Imperata	2	P	P

Genus.	Culm anatomy.	Leaf anatomy.	Epid.
Monocymbium	2	P	P
Miscanthidium	2	P	P
Sehima	2	P	P
Sorghum	2	P	P
Themeda	2	P	P
Trachypogon	2	P	P
Urelytrum	2	P	P

DISCUSSION

Comparing the anatomical data presented in Table 1, it becomes evident that there is a close correlation between stem anatomy and leaf anatomy. The data have little value as such, but only supply another tool in studying grass phylogeny. Other characters which were proved to be useful in the taxonomy of the Gramineae are leaf anatomy (Duval-Jouve, 1875, Avdulov, 1931); histology of the epidermis (Prat, 1936); Cytology (Avdulov, 1931); embryo anatomy (Reeder, 1957); root-hair development (Row and Reeder, 1957); physiology (Harz, 1880, Cugnac, 1931, Al-Aish, 1956) and organization of the shoot apex (Brown, Heimsch and Emery, 1957.)

The data from stem anatomy further emphasize the difference in phylogenetic affinities between *Aristida* and *Stipa*. A further difference between *Danthonia* and *Asthenatherum* also becomes evident. In this respect *Danthonia* resembles the festucoid group and *Asthenatherum* the panicoid group of grasses. These anatomical data also show that the genera *Lasiochloa*, *Plagiochloa* and *Urochlaena* occupy an aberrant position in the tribe Eragrosteae.

SUMMARY

The culm was sectioned transversely about 1 cm. below the inflorescence. The bundles closest to the epidermis are flanked by parenchymatous cells which contain chloroplasts. Directly against the bundle these cells arrange themselves into a parenchymatous sheath which may be poorly differentiated or well developed and composed of small or large cells. It was pointed out that these anatomical data show a close correlation with data from leaf anatomy.

LITERATURE CITED

Al-Aish, M. (1956)..... The effect of isopropyl-n-phenyl carbamate on the germination of grass seeds and the bearing upon systematics of the Gramineae. Ph.D. Thesis, University of Texas.

Avdulov, N. P. (1931)..... Karyo-systematische Untersuchungen der Familie Gramineen. Bull. Appl. Bot. Suppl. vol. 44, 428 pp.

Brown, W. V., C. Heimsch and W. H. P. Emery (1957) The organization of the grass shoot apex and systematics. Amer. Jour. Bot. 44: 590–595.

Chippindall, L. K. A. (1955)..... The classification of grasses. The grasses and pastures of South Africa: 1–527.

Cugnac, U. de (1931)..... Recherches sur les glucides des Graminées. Ann. Sci. Nat. Bot. 10: 1–121.

de Wet, J. M. J. (1954)..... The genus *Danthonia* in grass phylogeny. Amer. Jour. Bot. 41: 204–211.

Duval-Jouve, M. J. (1875).....	Histotaxie des feuilles de Graminées. Ann. Sci. Nat. Bot. 14: 294–371.
Harz (1880).....	Beitrage zur Systematik der Gramineen. Linnaea 43: 1–30 (Ex Avdulov, 1931).
Prat, H. (1936).....	La Systématique des Graminées Ann. Sci. Nat. Bot. 10: 165–258.
Reeder, J. R. (1957).....	The embryo in grass systematics. Amer. Jour. Bot. 44: 756–768.
Row, H. C. and J. R. Reeder (1957)..	Root-hair development as evidence of relationships among genera of Gramineae. Amer. Jour. Bot. 44: 596–601.
Stebbins, G. L. (1956).....	Cytogenetics and evolution of the grass family. Amer. Jour. Bot. 43: 890–905.

Notes on the Sapotaceae of Southern Africa.

By

A. D. J. Meeuse.

INTRODUCTION.

In view of the proposed "Flora of Southern Africa", the Sapotaceae of the area were studied. It soon became apparent that several South African species also occur in tropical Africa or are closely related to tropical species, and this necessitated the study of material from adjoining regions such as Angola, Rhodesia and Portuguese East Africa. Several species not recorded from the Union, but found in neighbouring areas are included in this treatment, either because they may be recorded later, or because they were interesting in connection with related South African forms.

This revision is mainly based on material from herbaria in Southern Africa. Several problems that could not be solved in this country were passed on to our officer stationed at Kew, Mr. B. de Winter. My thanks are due to Mr. de Winter, not only for his valuable assistance with taxonomical problems, such as comparing of type specimens and other material at Kew and in the British Museum (Nat. Hist.), but also for his kind help in obtaining abstracts of several publications which were not available here. Without his contribution many minor difficulties and doubtful points could never have been satisfactorily cleared up.

The material of the National Herbarium Pretoria, was studied and, in addition, material was kindly sent on loan by the following herbaria (abbreviations are, where possible, those of the latest Index Herbariorum by Lanjouw and Stafleu): BOL, COI, GRA, J, L, LM, NBG (including SAM), NH, NU, PRE (including TRV), SRGH; and Forestry Department Herbarium, Pretoria (SAFD).

History of the Study of Sapotaceae in Southern Africa.

The first comprehensive work, De Candolle's Prodromus Vol. 8 (1844) only mentions two species from Southern Africa, viz., *Sideroxylon inerme* L. and *Mimusops caffra* E. Mey. ex A. DC. Until the publication of Engler's monograph of all the African Sapotaceae in his series "Monographien Afrikanischer Pflanzenfamilien und Gattungen", Vol. 8 (1904)—cited in the following pages as "Mon. Sapot. Afr."—the study of Sapotaceae in Southern Africa was restricted to occasional descriptions of new species such as by Sonder in Linnaea 23 (1850) and by N. E. Brown in Kew Bull. 1895.

The Sapotaceae of tropical Africa were treated by Baker in Flora of Tropical Africa 3 (1877), but only very few of the species mentioned extend into South Africa.

In 1906 the family was treated in Flora Capensis, Vol. 4 (1), by C. H. Wright, whose account was partly based on unpublished notes left by Harvey. This treatment added very little to Engler's monograph and is not critical, in fact, most descriptions are practically literal translations of those given by Engler. Phillips, in Genera S. Afr. Flow. Pl. ed. 1 (1926), recognised three genera, viz. *Sideroxylon* (with 2 species in S. Africa), *Chrysophyllum* (3 spec.) and *Mimusops* (11 species). In the second edition

of the Genera (1951), Phillips maintains the same 3 genera with 2, 3, and 12 species respectively. As will be pointed out later, his conception of the Sapotaceous genera cannot be maintained and more genera have to be recognised if present trends are accepted. The late Father J. Gerstner, finally, treated the family in two papers which are rather superficial as far as systematics and nomenclature are concerned, but most valuable on account of important field-notes; cf. J. S. Afr. Bot. 12: 47–55 (1946), and 14: 171–174 (1948). Gerstner's work has clarified the status of *Chrysophyllum wilmsii* Engl. and of *Mahea natalensis* Pierre (= *Mimusops natalensis* Engl. non Schinz). He recognised 5 genera. The following Table gives a comparative analysis of the species mentioned in the more comprehensive publications and the present author's interpretation (Cf. Table I).

Delimination of the genera,

The genera of Sapotaceae are not very sharply defined and the modern monographers are inclined to " moderate splitting ", which trend is followed here. For a more detailed account of the history of the generic taxonomy and of the various systems of classification, see Baehni, Candollea 7: 394–508 (1938).

The most recent systems of classification are those published by Baehni (l.c.) and by Lam (Occ. Papers. Bern. P. Bishop Mus. Honolulu 14, no. 9: 137–141 (1938), and Rec. Trav. Bot. Néerl. 36: 524 (1939). Although these two systems are basically entirely different, these authors agree in several essential points and in the delimitation of most genera. The most important feature of the most recent classifications, as far as the S. African representatives are concerned, is the segregation of the several genera from the large and heterogeneous genus *Mimusops sensu* Engler (1904), such as *Manilkara, Muriea, Lecomtedoxa, Baillonella* and others.

In this revision many more genera are accepted than was done by Phillips in his " Genera ", but it is considered preferable to follow modern monographers of the family rather than one general, and consequently unspecialized, reference work.

FAMILY CHARACTERS.

Trees often attaining a large size or sometimes shrubs, occasionally climbing, containing latex ducts in all parts (even the fruits). *Leaves* alternate, almost invariably petiolate, undivided and usually with entire margin, often more or less leathery; stipules often present but usually early deciduous, setaceous or linear-subulate. *Flowers* axillary but often on older branches or stems, generally solitary or fascicled, sessile or pedicelled, regular, almost invariably bisexual, usually small but often fragrant. *Calyx* consisting of one or two whorls of free or nearly free sepals, usually with a rusty-brown pubescence on the outside; sepals 2–5, occasionally more, in each whorl, usually entire, often firm to coriaceous. *Corolla* gamopetalous, usually cream or white and almost invariably glabrous, consisting of a tube and one or two whorls of 2–5 or occasionally more lobes; the tube usually cylindric to campanulate, usually short; the lobes imbricate, entire or occasionally fringed, in several genera each lobe bearing two lateral petaloid appendages of various sizes, sometimes nearly as large as the lobe itself, sometimes much smaller. *Alternipetalous staminodes* as many as there are petals in one whorl, or fewer, or absent, varying from rather large and petaloid to small and scale-like, entire, or variously fringed, lobed or dissected, glabrous or hairy. *Epipetalous staminodes* sometimes present, but if so they are transformed, sterile or abortive stamens and often resemble the latter in shape. *Stamens* in one or two whorls (occasionally in more whorls, not in Southern Africa), as many per whorl as the number of corolla-lobes or twice as many or fewer, inserted in the mouth of the corolla-tube or sometimes lower down; filaments usually present but generally short; anthers 2-thecous; thecae usually extrorse, dehiscing with longitudinal slits. *Ovary* usually

TABLE I.—THE SAPOTACEAE OF SOUTHERN AFRICA (COMPARATIVE ANALYSIS)

Author. Genus.	A.DC., Prodr. VIII (1844).	Baker in Fl. Trop. Afr. IV (1874).	Engler, Mon. Afr. Pfl. fam. u. Gattungen, VIII., Sapot. (1904).	C. H. Wright in Fl. Cap. IV, 1 (1906).	J. Gerstner in J. S. Afr. Bot. 12 (1946) [illegible]	Present revision.
Sideroxylon	Sideroxylon inerme L.	—	Sideroxylon inerme L.	Sideroxylon inerme L.	Sideroxylon inerme L.	Sideroxylon inerme L.
		Sideroxylon diospyroides Baker	Sideroxylon diospyroides Baker	Sideroxylon Randii Sp. Moore	(Not mentioned)	= Sideroxylon inerme = Pouteria magalismontana
Chrysophyllum		Chrysophyllum magalismontanum Sond.	Chrysophyllum magalismontanum Sond. Chrysophyllum natalense Sond. Chrysophyllum Wilmsii Engl. Chrysophyllum argyrophyllum Hiern Chrysophyllum antunesii Engl. Chrysophyllum carvalhoi Engl. Chrysophyllum gorungosanum Engl.	Chrysophyllum magalismontanum Sond. Chrysophyllum natalense Sond Chrysophyllum Wilmsii Engl.	Chrysophyllum magalismontanum Sond. Chrysophyllum natalense Sond = Chrysophyllum magalismontanum Chrysophyllum viridifolium Weed et Franks	= Pouteria magalismontana (Sond.) A. Meeuse = Pouteria natalensis (Sond.) A. Meeuse = Pouteria magalismontana Pouteria magalismontana Pouteria magalismontana Pouteria magalismontana Chrysophyllum gorungosanum Engl. Chrysophyllum viridifolium Weed et Franks
Pouteria		(Under Chrysophyllum) (Sideroxylon brevipes Baker)	(Chrysophyllum) (Chrysophyllum) Pachystela brevipes (Baker) Engl. Pachystela cinerea (Engl.) Pierre	(Chrysophyllum) (Chrysophyllum)	(Chrysophyllum magalismontanum) (Chrysophyllum natalense)	Pouteria magalismontana (Sond.) A. Meeuse Pouteria natalensis (Sond.) A. Meeuse Pouteria brevipes (Baker) Baehni = Pouteria [illegible]
Vincentella						Vincentella sapinii (De Wild). Brenan
Mimusops	Mimusops caffra E. Mey. ex A.DC.	Mimusops kirkii Baker Mimusops mochisia Baker	Mimosops caffra E. Mey. ex A.DC. Mimusops kirkii Baker Mimusops mochisia Baker Mimusops obovata Sond. Minusops woodii Engl. Mimusops oleifolia N.E.Br Mimusops zeyheri Sond Mimusops densiflora Engl. Mimusops menyhartii Engl. Mimusops fischeri Engl. Mimusops zanzibarensis Engl. Mimusops marginata N.E.Br Mimusops schinzii Engl. Mimusops dispar N.E.Br. Mimusops discolor (Sond.) Hartog Mimusops natalensis (Pierre) Engl. Mimusops henriquesii Engl. et Warb.	Mimusops caffra E. Mey ex A.DC. Mimusops obovata Sond. Mimusops woodii Engl. Mimusops oleifolia N.E.Br. Mimusops zeyheri Sond. Mimusops marginata N.E.Br. Mimusops schinzii Engl. Mimusops dispar N.E.Br. Mimusops discolor (Sond.) Hartog Mimusops natalensis (Pierre) Engl. Mimusops concolor Harv. ex Wright	Mimusops caffra E. Mey. Mimusops kirkii Baker Mimusops mochisia (1946) [illegible] Mimusops obovata Sond. = Mimusops obovata = Mimusops obovata Mimusops zeyheri Sond Mimusops marginata N.E.Br. Mimusops schinzii Engl. (Not mentioned) = Labourdonnaisia discolor = Labourdonnaisia discolor " Mimusops Henriquesiana Sim " Mimusops concolor (1946) [illegible]	Mimusops caffra E. Mey. ex A.DC. = Mimusops [illegible] = Manilkara [illegible] Mimusops obovata Sond. = Mimusops obovata = Mimusops obovata Mimusops zeyheri Sond = Manilkara [illegible] = Manilkara [illegible] Manilkara spec. (M. [illegible]) = Manilkara [illegible] = Austromimusops marginata = Austromimusops [illegible] = Austromimusops [illegible] Mimusops [illegible] Mimusops [illegible] Lecomteodoxa henriquesii Manilkara concolor
Austromimusops			(Mimusops marginata) (Mimusops dispar)	(Mimusops marginata) (Mimusops dispar)	(Mimusops marginata)	Austromimusops marginata (N.E.Br.) A. Meeuse. Austromimusops dispar (N.E.Br.) A. Meeuse. Austromimusops sylvestris (Sp. Moore) A. Meeuse.
Manilkara		(Mimusops mochisia Baker)	(Mimusops mochisia) (Mimusops zanzibarensis)	(Mimusops concolor)	" Manilkara mochisia (Baker) Gerstn." " Manilkara concolor (E. Mey.) Gerstn."	Manilkara mochisia (Baker) Dubard Manilkara zanzibarensis (Engl.) Dubard Manilkara concolor (Harv.) Gerstn. Manilkara macaulayae (Hutch. et Corb.) H. J. Lam
Muriea			(Mimusops discolor) (Mimusops natalensis)	(Mimusops discolor, Mimusops natalensis)	Labourdonnaisia discolor Sond.	Muriea discolor (Sond.) Hartog
Lecomtedoxa			(Mimusops henriquesii)		(Mimusops henriquesiana Sim)	Lecomteodoxa henriquesii (Engl. et Warb.) A. Meeuse

5- to many-locular with a single ovule in each locule; style cylindric or more or less conical or subulate, ending in an acute or capitellate stigma; ovary superior, often rusty-pubescent. *Fruit* a berry with a usually thin outer layer and a juicy or mealy, rarely tough and leathery pulp in which the seeds are embedded. *Seeds* as many as there are ovules or fewer, compressed or tumid; testa either hard (" bony ") and in this case usually smooth and shiny, or leathery to crustaceous and in this case often dull, with an attachment area (cicatrix or " scar ") containing the hilum; cicatrix basal or lateral, small and circular or large, sometimes covering about half the surface area of the seed, of a different texture (duller and rougher than the testa and usually thinner and softer); endosperm either copious and found on either side of the flat foliaceous cotyledons, or scanty to absent and in this case the cotyledons thick and fleshy.

An almost completely tropical family comprising over 600 described species in a number of genera which are very difficult to define, because there is hardly any other family of the Phanerogams where the characters integrate and overlap to such an extent. For this reason the number of " genera " varies from author to author, some recognising about a dozen, others up to 120, but following present trends about 40 genera can be recognised. Another difficulty is that genera which appear to be rather sharply defined in one area may show intermediates in another region of the world and only a world-wide study can reveal the relationships. Several genera are already known to occur in more than one continent (*Pouteria* and *Manilkara* are circumtropical, *Mimusops* occurs in Africa and tropical Asia, *Chrysophyllum* is found in America and Africa and possibly occurs in Asia as well) and more similar links may be found.

Key to the genera.

As the genera of Sapotaceae are not very sharply defined, and both characters of the flower and the seed are used in their classification, the following key will not always lead direct to the proper genus if only flowers or only fruits are available, but the alternatives are indicated. Two characters used in the key need some explanation. In several genera the corolla-lobes occur in groups of three. The generally adopted conception is that each corolla-lobe, which is the central one of each group of three, bears two " lateral (or dorsal) appendages " which are often interpreted as stipules. Only Gilly [in Trop. Woods 73 (1934), p. 1-22] developed a different theory, viz., that in genera such as *Mimusops* and *Manilkara* the biseriate calyx of most authors represents the calyx and the corolla, the inner whorl being the true corolla, whereas the corolla of other authors is interpreted as an outer whorl of staminodes. It is not very likely that Gilly's views will be generally adopted, because there are genera having a *monoseriate* calyx and corolla-lobes with lateral appendages (*Bumelia*). The African genus *Lecomtedoxa* often shows sub-biseriate calyces and corolla-lobes with small lateral appendages and forms a link between the groups with biseriate calyces and (mostly) lateral appendages to the corolla-lobes (included by Lam in his subfamily Mimusopoideae) and the groups with mostly monoseriate calyces and usually without lateral appendages (Lam's Sideroxyloidea-Pouteriinae).

The other character used is the " scar " or cicatrix of the seed (*area derasa* of Baehni). The part of the testa by which the seed is or was attached to the inside of original loculum of the ovary is usually very distinct from the rest of the testa by a paler colour, a less smooth surface, a surrounding rim, location in a depression of the seed, etc. The shape and size of this area form a very good distinguishing character.

Flowers generally 5-merous; sepals in one whorl or at least never manifestly biseriate; lateral appendages to the corolla-lobes absent (only in *Lecomtedoxa* present):

Corolla-lobes without lateral appendages; flowers rather strictly 5-merous throughout:

Berry globose, 1-seeded; seed depressed-globose, bluntly 4- or 5-angled or somewhat ribbed, with a small circular cicatrix; alternipetalous staminodes always as many as the corolla-lobes and about as long, petaloid, usually triangular to lanceolate from a broad base; corolla-lobes not strongly reflexed.... 1. *Sideroxylon.*

Berry usually ovoid to oblong; seed ellipsoid, ovoid or oblong, not angular or somewhat ribbed, with a lateral, usually long and sometimes very large scar:

Fruits usually 3–5-seeded; seeds laterally compressed with a hard, shiny bony testa and narrow linear scar; endosperm copious, cotyledons thin and foliaceous; alternipetalous staminodes O (if fruit lacking and staminodes O, see also 3. *Pouteria*)..... 2. *Chrysophyllum.*

Fruits usually 1-seeded, sometimes 2-seeded; seeds usually not much compressed, with a thin, more crustaceous testa; scar linear or very large and occupying the ventral half of the seed; endosperm O, cotyledons thick and fleshy; alternipetalous staminodes 1–5, or absent:

Corolla-tube short but distinct; petals not strongly reflexed; filaments rather short and stoutish, stamens therefore not or but slightly exerted; ovary in flower not conspicuous..... 3. *Pouteria.*

Corolla-tube very short to almost O; petals completely reflexed; filaments long and slender, erect and hence stamens almost completely exerted; ovary exposed, comparatively large and conspicuous. 4. *Vincentella.*

Corolla-lobes with lateral appendages; whorls of flower 3–6-merous; alternipetalous staminodes present, as many as the corolla-lobes; fruit large (± 4 cm. by 2–2·5 cm.), 1-seeded, with an oblong large lateral scar; seed without endosperm..... 5. *Lecomtedoxa.*

Flowers generally 3–4-merous, sepals always distinctly biseriate, corolla-lobes usually each with 2 petaloid lateral appendages, very rarely appendages small or O:

Flowers generally 4-merous; alternipetalous staminodes more or less lanceolate, entire (except sometimes their tips), hairy outside; lateral appendages of the corolla-lobes always well-developed:

Seed ellipsoid, not or but slightly laterally compressed, with a pergamaceous or crustaceous, not very shiny or quite dull testa and a large scar occupying most of the ventral half of the seed; endosperm O, cotyledons thick and fleshy; leaves distinctly crowded at the ends of the branches, usually not coriaceous nor shiny, with a fine usually conspicuous reticulate nervation; flowers in lower leaf-axils, often pendulous; ovules not basally attached 6. *Austromimusops.*

Seeds laterally flattened with a hard and shiny testa and a basal or sub-basal circular scar; endosperm present; cotyledons flat; leaves not distinctly crowded at the ends of the branches, usually more or less coriaceous, shiny on upper surface, the nervation usually not finely reticulate; flowers in the leaf-axils or sometimes also on naked branches; ovules basally attached..... 7. *Mimusops.*

Flowers generally 3-merous; alternipetalous staminodes various, entire or more or less divided, lobed, lacerated or fimbriate, glabrous, or absent and stamens twice as many as there are corolla-lobes (i.e., usually 12); rarely some or all stamens sterile and resembling staminodes; seed with endosperm and flat, foliaceous cotyledons:

Stamens as many as there are corolla-lobes (i.e., usually 6), alternating with as many or nearly as many alternipetalous staminodes; in the South African species corolla-lobes always with well-developed, lateral appendages and testa hard..... 8. *Manilkara.*

Stamens twice as many as there are corolla-lobes (i.e. usually 12); alternipetalous staminodes O, but occasionally some or all the stamens abortive and reduced to sterile staminode-like organs (in the latter case the normally present, lateral appendages to the corolla-lobes small or occasionally O); testa rather thin, crustaceous and brittle when dry..... 9. *Muriea.*

1. SIDEROXYLON

L., Gen. Pl. ed. 5, 89 (1754); Roem. et Schult., Syst. 4: 45 (1819); Endl., Gen. 739 (1837); Harvey, Gen. S. Afr. Plants 224 (1838); A.DC., Prodr. 8: 177 (1844), pro parte; Benth. et Hook. f., Gen. Pl. 2, 2: 655 (1876), pro parte; Baker in Oliv., Fl. Trop. Afr. 3: 503 (1877), pro parte; Engler in Engler-Prantl, Natürl. Pflanzenfam. 4, 1: 143 (1890), pro parte, and Mon. Sapot. Afr. 25 (1904), pro parte; Harvey ex Wright in Dyer, Fl. Cap. 4, 1: 142 (1906); Baehni in Candollea 7: 49 (1938), pro parte; H. J. Lam in Rec. Trav. Bot. Néerl. 36: 521 (1939); Phillips, Gen. S. Afr. Fl. Plants, ed. 2, 567 (1951).

Calvaria Comm. sensu Dubard in Ann. Mus. Col. Marseille 20: 84 (1912); H. J. Lam in Occ. Papers Bern. P. Bishop Mus. Honolulu 14, no. 9: 138–139 (1938); Adamson in Adamson and Salter, Fl. Cape Penins. 667 (1950).

Type Species: *Sideroxylon inerme* L. (see discussion below).

Trees or shrubs. *Flowers* normally 5-merous throughout, all whorls single. *Corolla-lobes* without lateral appendages *Alternipetalous staminodes* petaloid, with a broad base. *Ovules* basally attached. *Berry* 1-seeded. *Seed* depressed-globose, usually more or less 4- or 5-angled and somewhat ribbed; scar small, circular, situated in a basal depression of the seed; testa thick and bony; endosperm copious; cotyledons thin, foliaceous; embryo in the type species horizontal.

There has been a considerable amount of disagreement as regards the delimitation of the genus. Basing the genera of Sapotaceae almost exclusively on the structure of the flowers Bentham and Hooker and Engler included many forms with the flower pattern: sepals 5, petals 5 without lateral appendages, alternipetalous staminodes 5, stamens 5, ovarium 5-loculated, in one lage genus *Sideroxylon* which is certainly not homogeneous. Pierre, and later Dubard [see Ann. Mus. Col. Marseille 20 (1912)], using other characters apart from the floral structure, (e.g. the seeds) came to the conclusion that only a few species had to be retained in *Sideroxylon*, excluding, for instance, all forms which do not possess a basal scar. Unfortunately, Dubard placed the type species *S. inerme* L. in the genus *Calvaria* Comm. emend. Dub., as distinct from *Sideroxylon* L. sensu Dub. (in which he includes forms with a basal scar but not with a horizontal embryo as in *Calvaria* sensu Dub.).

The generic description agrees in principle with the delimination of the genus as understood by Baehni (op. cit.). Baehni mentions *Sideroxylon inerme* as the type species, but his description of the genus contains an error; the berry is said to be 4-seeded. This is obviously a misprint or an oversight, because he clearly agrees with Dubard's ideas although he points out that Dubard erred when he took up the name *Calvaria*. Baehni is also inclined to include Dubard's genus "*Sideroxylon*" (Dub., op. cit., p. 81): "Nous adoptons l'idée de Dubard qui consiste à resteindre le genre aux seules espèces à cicatrice basilaire, mais nous y réintégrons cependant les *Calvaria* sensu Dubard" (Baehni, op. cit., p. 492). This seems to be reasonable, because Dubard's genus *Calvaria* (=*Sideroxylon* sensu str.) and his genus *Sideroxylon* (=*Mastichodendron* Jacq.) differ only in the position of the embryo. Under this delimitation the genus includes a few species in America, probably only two in Africa and a few in Asia.

As regards the fixation of *S. inerme* as the type species, Linné mentioned two species in Sp. Pl. ed. 1, viz. *S. inerme* and *S. spinosum*. Both are properly defined and have never been confused with any other species. *S. spinosum* was placed in the monotypic genus *Argania* by Roemer and Schultes (Syst. Veg. 4: 46) as *Argania Sideroxylon* R. et S. [=*Argania spinosa* (L.) Skeels], leaving *S. inerme* L. as the only species in *Sideroxylon* and thus typifying it.

Sideroxylon inerme *L.*, Sp. Pl. ed. 1: 192 (1753); Burm. f., Prodr. Fl. Cap. 6 (1768); Drege, Zw. Pflanzeng. Doc. 144, 153 (1843); A. DC. in DC., Prodr. 8: 182 (1844); Wood, Natal Pl. 4, 1: pl. 314 (1903) Engl., Mon. Sap. Afr. 27, t.8 fig. B (1904), incl. var. *schlechteri* Engl.; Wright in Dyer, Fl. Cap. 4, 1: 438 (1906); Sim, For. Fl. Cape Col. 252, pl. 295 (1907); Marloth, Fl. S. Afr. 3: 36 pl. 10 (1932);Gerstner in J. S. Afr. Bot. 12: 47, fig. 1 (1946). *S. cinereum* Lamk., Encycl. 1:244, (1789), partim; Drege, op. cit., 222. *S. diospyroides* Baker in Oliv., Fl. Trop. Afr. 3: 502 (1877); Engler, op. cit. 27, t. 27, fig. A.

Myrsine querimbensis Klotzsch in Peters, Reise Mossamb., Bot. 185 (1862).

Calvaria inermis (L.) Dubard in Ann. Mus. Col. Marseille 20: 86 (1912), incl. var. *zanzibarensis* Pierre ex Dub.; Adamson in Adams, and Salter, Fl. Cape Penins, 667 (1950). *C. diospyroides* (Baker) Dub., op cit. 87.

A shrub or small tree, up to 8 m. occasionally 10–20 m. high, but usually branched from the base and not forming a clean bole. *Innovations* reddish-brown tomentose. *Leaves* in vivo dark green and shiny above, paler below, often drying a peculiar dull greyish-green colour above, pale greyish brown beneath, occasionally (and especially the younger ones) drying dark olive-green above and reddish beneath, usually quite glabrous (except when very young), but occasionally with irregular chocolate-coloured, often powdery, patches of adpressed hairs; blade usually elliptic to obovate-oblong, more rarely (ob-)ovate, ovate-lanceolate, obovate-spathulate or (ob)lanceolate, 4–9 (–12) cm. long and 2–4 (–5) cm. wide, with subreflexed edges, obtuse (sometimes emarginate or retuse), its base acute or subacute, sometimes distinctly cuneate, always more or less decurrent on the petiole; midrib prominent beneath, secundary nerves 7–10 on either side, thin, more or less immersed and not very conspicuous; tertiary nerves not to hardly distinguishable from the fine reticulate nervations, the latter in older (dried) leaves often inconspicuous, but quite distinct in younger ones; petiole rather stout, often thickened towards the base, at first rusty-tomentose but soon quite glabrous, at least near the top distinctly winged by decurrent leaf, 6-10 (–15) mm. long. *Flowers* disagreeably scented, in few to many-flowered and sometimes very dense fascicles, occasionally (a few) flowers solitary, in the axils of the lower leaves on the branches, sometimes also on the naked branches just below the leaves, often raised on short warts. *Bracts* minute, deciduous, rufo-tomentose. *Pedicels* rather thick, slightly and gradually broadening towards the top, not very abruptly passing into the calyx, 2–12 mm. long, sparingly whitish-pubescent, in fruit hardly lengthening but becoming much stouter, 1–1¼ mm. thick and often glabrescent. *Calyx* 2–2½ mm. long, the lobes about as long as the calyx-tube, broadly ovate, subacute, erect, entire, ciliate, with a paler edge when dry, finely and sparingly whitish-pubescent, in fruit adpressed, scarcely accrescent. *Corolla* greenish-white, about twice as long as the calyx-lobes, rotate, up to about 5 mm. across; tube short, lobes usually longer than the tube, ovate, entire, obtuse, glabrous. *Stamens* inserted in the throat of the corolla tube, longer than the corolla lobes. *Alternipetalous staminodes* ovate-lanceolate to oblong or oblong-lanceolate, as long as or slightly shorter than the corolla lobes, but always less wide than the latter, usually more or less distinctly incised, serrate, lacerate, dentate, crenulate or with a wavy edge, acute, acuminate or obtuse, sometimes tri- or multi-dentate at the apex. Ovary conical-semi-ovoid, covered with rather long adpressed white hairs (except in a zone near the base), usually 5-celled but occasionally 3, 4- or 6-celled; style about the same length as the ovary, glabrous. *Berry* black, globose, smooth, up to 12 mm. in diam. when fresh, when dry up to 10 mm. in diam. and wrinkled, usually crowned with the short persistent style; pulp purple or purplish-green, with white viscid juice; the latex long remaining sticky in dried specimens. *Seed* black when fresh but drying a shiny yellowish brown, usually depressed semi-globose or ellipsoid, rarely higher than broad, usually more or less disctinctly 4- or 5-angled and 5-ribbed, sometimes indistinctly lobed, 6–8 mm. long, 5–7 mm. wide and 5–8½ mm. high rarely up to 9½×8×7½ mm., with several (4 or sometimes more) more or less distinct grooves which are most conspicuous near the scar, and with 2–4 small impressions between the grooves close to the scar.

Cape Province.—Cape Peninsula: *Marloth* 584; Chapmans' Bay, *Wolley Dod* 3444 (BOL); Gordon's Bay, *Gerstner* 6144; Witsand, *Smuts* 1190. Caledon: Onrust Riv., *Schlechter* 10396. Bredasdorp: Bredasdorp, *Smith* 2587. Riversdale: Riversdale, *Muir* 148; *Marloth* 3536. Mossel Bay: leg. *Town Clerk*, *Mossel Bay* (specimen of the "Post Office Tree", declared a national monument, PRE herb. no. 28382). Knysna: *Kapp* 100; *Fourcade* 623 (BOL). Humansdorp: *Phillips* 3328; Klipdrift,

Thode 2490 (PRE). Uitenhage: *Alexander; Ecklon* or *Ecklon & Zeyher* (L); *Ecklon & Zeyher* (GRA). *Zeyher* 17 (BOL); Zwartkopsrivier, Drege (L). Port Elizabeth: Redhouse, *Mogg* 4672 (PRE). Alexandria: Kariega, *White* 101 (GRA). Bathurst: Karouga Mouth, *Britten* 2350; Kowie and Pt. Alfred, *Tyson* s.n.; *Britten* 1885; *Barker* 2106. Albany: near Riebeeck East, *Dyer* 3321. Alice: *Acocks* 8987. Fort Beaufort: *Story* 1698. Stutterheim: Fort Cunynghame, *Galpin* 2468. King Williams Town: near King Williams Town, *Comins* 1031. East London: *Smith* 3816, *Galpin* 9843. Queenstown: near Queenstown, *Galpin* 8137. Komgha: Komgha, *Flanagan* 777; Kei Mouth, *Flanagan* 770. Kentani: *Pegler* 882. Port St. Johns: *Galpin* 11465. Cape without precise locality: specimen in Linnaean herbarium (photo in PRE), lectotype!

Natal.—Port Shepstone: Paddock, Oribi Gorge, *McClean* 267. Umzinto: Umkomaas, *Pennington* s.n. (NH no. 27756). Pinetown: Isipingo, *Ward* 570; Amanzimtoti: *Kotze* 452 = FD Herb. 6875. Durban: near Durban, *Wood* 8707, 9578. Inanda: Tongaat Beach, *Hillary* 375 (NU). Lower Tugela: Darnall, *Schmidt* 41 (NH). Estcourt: Mooi River, *Wood* 6306. Weenen: between Weenen and Estcourt, *Edwards* 702. Msinga: near Tugela Ferry, *Edwards* 935. Mtunzini: *Lawn* 623 (NH). Eshowe: Eshowe, *Gerstner* 1945 (NH). Hlabisa: False Bay, *Gerstner* 4818; Hluhluwe Game Reserve, *Ward* 1895. Ngotshe: near Magut, *Acocks* 13023; *Codd* 1961; *West* 2117.

Swaziland: on road to Komatipoort, *Pole Evans* 3463, 3467; near Stegi, *Compton* 26017; *Rodin* 4548, Usutu River, *Miller* S249.

Transvaal.—Nelspruit: Kruger National Park, near Pretorius Kop, *Codd* 6029; near Skukuza, *Codd* 5735. Barberton: Komatipoort, *Rogers* 20800; *Codd* 7776.

Portuguese E. Africa.—Sul do Save, Maputo, *Hornby* 2668; *Myre & Balsinhas* 607; between Umeluzi and Porto Henrique, *Myre & Carvalho* 92; Lourenço Marques, *Schlechter* 11710 (L, GRA, PRE, BOL; type no. of *S. inerme* L. var. *Schlechteri* Engl.); *Borle* 418; *Bremekamp* LM60a; *Rodin* 4173; Porto do Oura Beach, *Gomes e Sousa* 3926; Inhaka Island, *Mogg* sm., Mrs. *Moss* s.n.; Goba Mts, *Tôrre* 6490; Nuanetsi-Limpopo Valley nr. Transvaal Border, *Smuts* P. 322, Guifa, *Pedro & Pedrogão* 2135; between Muianga and Macia: *Pedrogão* 1443; near Chibuto, *Pedro & Pedrogão* 1534; between Su Larrime and Ganda, *Pedro & Pedrogão* 1890. Sabi River, near Meringua, *Chase* 2535. Niassa: near Cabo Delgado, *Barbosa* 2167 (LM).

Tanganyika Terr.—Morogoro Distr.: Kwaba, *Wigg* 974. Kisarawe distr.: Kisiju, *Semsei* 1377, *Paulo* 153.

Kenya Col.—Greater Kiboko River: *Jarrett* 518.

Mr. B. de Winter kindly examined the Linnaean Herbarium in London and informed me that there is only one specimen which is undoubtedly *Sideroxylon inerme* and must be considered to be the lectotype (Mr. de Winter matched it with a specimen *Hutton* s.n. from Fish River Heights, Albany, C.P.). *S. inerme* was one of the first Sapotaceae known in Europe and one of the oldest plates is found in Burman, Dec. Rar. Afr. (1738), p. 238, t. 94, fig. 2. The seed is unmistakable and Burman also mentions: " . . in Cod. Wits. . . . latescens . . . vocatur ".

This plant was described from South Africa by Linné and, in its typical form with comparatively narrow leaves and long pedicels, is found from the Cape Peninsula eastwards along the coast to Natal and extends into Portuguese East Africa. Baker

described a species *S. diospyroides*, from Zanguebar in tropical East Africa, which has smaller flowers, short pedicels and obovate-cuneate leaves. Engler remarked on the similarity between the two, but mentioned the following differences:—

(1) pedicels of *S. diopyroides* shorter than in *S. inerme*,

(2) staminodes broader and acuminate in *S. diospyroides*, narrower and not acuminate in *S. inerme*.

(3) seed of *diospyroides* smaller than that of *S. inerme*.

Acuminate and broad staminodes and small seeds are, however, also found in specimens of *S. inerme* from the Cape and Mr. de Winter, who studied the material at Kew, informed me that the only difference he could find was in the length of the pedicels.

The material from Portuguese East Africa is very often intermediate and includes forms with narrow leaves, short pedicels and small fruits and forms with broad leaves (as in typical *S. diospyroides*) with large seeds, etc. These intermediate specimens link up the two forms so that in my opinion, *S. diospyroides* only represents a minor geographical variant of *S. inerme* and is not even worthy of varietal rank.
Doubtful localities are: " Near Pretoria ", *McLea* in herb. Bolus no. 5698 (BOL, PRE), because this species has never since been found near Pretoria, and " Johannesburg: Melville ": *Moss* 15906 (J). Dr. J. B. Gilliland, formerly of the Dept. of Botany, Witwatersrand University, has kindly informed me that there is no trace of the species anywhere in the Witwatersrand area.

Excluded species:

Sideroxylon argenteum Thunb., Prodr. Fl. Cap. 36 (1794) = *Rhus thunbergii* Hook. = *Heeria argentea* (Thbg.) Meissn.

Sideroxylon randii S. Moore = *Pouteria magalismontana* (Sond.) A Meeuse (see p. 335).

Sideroxylon dentatum Burm. f., Prodr. Fl. Cap. 6 (1768) = *Curtisia dentata* (Burm. f.) C. A. Smith in J. S. Afr. Forestry Assoc. *20*: 34, 50 (1951). This species was legitimately published, as Burman based it on the plate and description of his father's *Sideroxylon foliis acuminatis dentatis, fructu monospermo flavo* [Burm., Dec. Rar. Afr. Plant. (1738), p. 235, t. 82]. The plant in question is undoubtedly the same as published by Aiton [Hort. Kew ed. 1 (1789), p. 162] under the name *Curtisia faginea*. Not only are the elder Burman's plate and description quite adequate to recognise the species, but he also mentioned the name " Assagay-Boom " used by the Dutch at the Cape, under which name it is still known. Moreover, Aiton, l.c. quotes " Burm. Afr. p. 235 t. 82 " and the phrase name " *Sideroxylon foliis acuminatis* etc.", and Harvey in Harv. and Sond., Fl. Cap. 2: 570, sub *Curtisea faginea* Ait., also mentioned " Burm. Dec. Afr. p. 235, t. 82 ". This identity had already been recognised by the late C. A. Smith, who did not give any reasons, however, when he proposed the above-mentioned change of name.

2. CHRYSOPHYLLUM

L., Gen. Pl. ed. 5, 89 (1754); A. DC. in DC., Prodr. 8: 56 (1844); Benth. et Hook. f., Gen. Pl. 2: 653 (1876); Baker in Oliv., Fl. Trop. Afr. 3: 498 (1877), ex parte: Engler in Engler & Prantl., Nat. Pflanzenfam. ed. 1, 4, 1: 147 (1890), pro majore parte, in Nachträge 278 (1897), and Mon. Sap. afr. 38 (1904) ex parte et exclus. Section *Zeyherella;* Wright in Dyer, Fl. Cap. 4: 436 (1906), pro parte; Pilger in Engler & Prantl, Pflanzenf., Nachträge 1897–1907: 288 (1908); Hutch. & Dalz., Fl. W. Trop. Afr. 2, 1: 8 (1931); Eyma in Rec. Trav. Bot. Néerl. 33: 201 (1936), (with discussion on p. 157–158); Bachni in Candollea 7: 429 (1938); Phillips, Gen. S. Afr. Flow. Pl. ed. 2, 568 (1951) pro parte.

Donella Pierre ex Baill., Hist. d. Pl. 11: 294 (1892).

Gambeya Pierre, Not. bot. Sapot. 61 (1891); Baillon, Hist. d. Pl. 11: 296 (1892).

Type species: *C. cainito* L., Sp. Pl. ed. 1, 192 (1753).

Trees or shrubs, rarely climbing; ultimate branches and lower surface of leaves often densely adpressed-tomentose; lateral nerves of leaves parallel, close or distant, usually spreading and curved near the margin; tertiary nerves usually inconspicuous. *Stipules* wanting or at least very early deciduous. *Flowers* axillary, or on the naked branches below the leaves, solitary or in fascicles, rarely sessile, usually isomerous. *Sepals* 5 (rarely 4, 6 or 7); lobes entire, imbricate. *Corolla* 5 (4-, 6- or 7-) lobed; lobes entire, imbricate; tube cylindric, urceolate or campanulate, usually short. *Alternipetalous staminodes* 0. *Stamens* usually short, not or but little exerted; filaments inserted in the throat of the corolla tube at the base of the lobes and short, or inserted lower down and longer; anthers versatile, more or less dorsifix, ovate to triangular, often apiculate, sometimes somewhat sagittate at the base. *Ovary* hairy, 5- or more rarely 4-, or 6-7-loculated; style columnar, short, thick, glabrous; ovules with lateral or basilateral attachment. *Berry* 1- to few-seeded, but usually 3-5-seeded. *Seeds* with long and narrow ventral scar; testa hard, smooth and shiny; endosperm copious, cotyledons thin and foliaceous.

Between 100 and 200 species described, but undoubtedly some of them have been or have to be referred to other genera, because the absence of presence of alternipetalous staminodes is *not* a reliable character in Sapotaceae if not used in conjunction with other characters and many species without or apparently without staminodes but with seeds altogether different from the type species of *Chrysophyllum* were at one time or another placed in the genus *Chrysophyllum*. Krause, Engler and later Eyma (cf. Eyma, op cit., p. 157–158) and Baehni (op. cit., p. 405–406) criticised the systems of classification of Sapotaceae in which the character of the alternipetalous staminodes is over-emphasized, so that, e.g., a separate tribe "Chrysophyllinées" based on the absence of staminodes was recognised by Dubard. Eyma (l.c.) and Lam [in Rec. Trav. Bot. Néerl. 36 (1939), p. 509–525] pointed out the relationships with the Sideroxyleae and indeed *Chrysophyllum* is, in my opinion, to be included in this group. The genus *Chrysophyllum - sensu lato -* was split up (at least in Ms.) into a large number of smaller genera by Pierre (*Pachystela*, *Donella*, *Gambeya*, *Zeyherella*, *Malacantha*, etc.). Some of these genera were adopted by Engler (1904, l.c.) such as *Pachystela* and *Malacantha*. The remainder, at least as far as the African representatives are concerned, and if Engler's section *Zeyherella* is excluded, is a fairly homogenous group which is distinct from *Sideroxylon* s.l. and *Pouteria* s.l. in that the staminodes are completely lacking and the seed characters are different.

General Distribution: Mainly tropical America, less than 30 species in Africa, one in Madagascar; the few species recorded from tropical Asia, Australia and the Pacific have mostly been referred to other genera (e.g. *Nesoluma*).

The African representatives belong to two sharply defined subgenera:

(1) **Chrysophylum** *L.* subgenus **Donella** (*Pierre ex Baill.*) *A. Meeuse*, stat. nov. *Donella* Pierre ex Baill., Hist. d. Pl. 11: 294 (1891), pro gen. *Chrysophyllum* L. sect. *Donella* (Pierre ex Baill.) Engl., Mon. Sapot. Afr. 41 (1904).

Leaves with numerous close, parallel lateral veins, usually dark green above and as a rule quite glabrous; *corolla* with a short broad urceolate to subglobose tube.

Type species: *Chrysophyllum roxburghii* Don = *C. lanceolatum* (Bl.) DC. (India to New Guinea).

(2) **Chrysophyllum** *L.* subgenus **Gambeya** (*Pierre*) *A. Meeuse*, stat. nov. *Gambeya* Pierre, Not. Bot. Sapot. 61 (1891) (pro gen.). *Chrysophyllum L* sect. *Afrochrysophyllum* Engl. in Engl & Prantl., Nat. Pflanzenfam., Nachträge 272 (1897). *Chrysophyllum* sect. *Gambeya* (Pierre) Engl., Mon. Sapot. Afr. (1904).

Leaves with rather distant and usually on lower surface more or less prominent lateral veins and as a rule more or less rufo-tomentose on lower surface; *corolla* with a subcylindric to campanulate tube.

Type species: *Chrysophyllum subnudum* Baker (West Tropical Africa).

A few species of *Chrysophyllum* occur in Southern Africa, of which only two are treated here (one South African, the other occuring in Southern Rhodesia and Portuguese East Africa fairly close to the Union border):

Leaves almost completely glabrous and green when old, with fine parallel nervation, up to 11 cm., but usually under 8 cm. long..... 1. *C. viridifolium.*

Leaves rusty-tomentose or sometimes greyish tomentose beneath, often 10–20 cm. long; lateral nerves distant, very prominent beneath..... 2. *C. gorungosanum.*

1. **C. viridifolium** *Wood* et *Franks* in Wood, Natal Pl. 6: 569 (1912); Gerstner in J. S. Afr. Bot. 12: 48, Fig. 3 (1946) Type: *Franks* in herb. Wood No. 11636 from Stella Bush, Berea, near Durban, in NH, holo! photo in PRE!, in BOL and PRE, isos!).

A large tree, 10–30 m. high, with a girth at 2 m. from the ground of 150 cm. and over. *Trunk* usually unbranched for 5 m. or more, and strongly many-ribbed to the origin of the branches. *Bark* grey. *Innovations*, *petioles*, *pedicels*, and *calyx-lobes* finely rusty velvety-tomentose, the older twigs and fruiting pedicel glabrous. *Leaves* scattered on the branches, thinly coriaceous, exstipulate, 4–8 (–11) cm. long and 2–3·5 (–4·5) cm. wide (those of coppice shoots are the longest), oblong or (ob-) ovate-oblong, more rarely ovate or elliptic, obtuse or bluntly acuminate with oblong, obtuse about 8 mm. long and about 3 mm. wide acumen, more or less rounded but always decurrent at the base, dark glossy green above, lighter and dull beneath, glabrous when mature, except near the midrib and at the very base near the petiole beneath, with reflexed edge; midrib channelled above, prominent beneath and, at least when dry, discolourous, reddish or brownish; lateral nerves numerous (about 11 per cm.), patent but not quite horizontal, often forked, almost straight, parallel (hence the leaf appearing striate), joining the fine intramarginal vein close to the margin. *Petioles* 5–10 (–12) mm. long more or less dorso-laterally flattened, channelled above. *Flowers* 2–2·5 mm. long, nearly globose, in clusters in the axils of the lower leaves and on raised warts on the older twigs; clusters few- to many-flowered (sometimes with over 20 flowers); bracts very minute or wanting; pedicels thin, almost capillary, 4–5 mm. long. *Calyx-lobes* free nearly to the base, erect, concave, ciliate. *Corolla* scarcely longer than the calyx; tube urceolate; lobes erect, ovate-oblong-rotundate, very obtuse or rounded, ciliate (at least at the lateral margins). *Stamens* inserted half way down the corolla-tube or even lower; filaments terete, longer than the apiculate anthers. *Ovary* depressed-globose, 5-celled, densely rusty-villous, often somewhat lobed; style conical-cylindric from a broad base, thick, obtuse or truncate, longer than the ovary. *Berry* depressed-globose with a depression near the top (shaped like a small apple), often ribbed (at least when dried), 20–30 mm. long and 20–35 mm. in diam., smooth, glabrous, yellow when ripe with yellowish-white pulp saturated with white latex, 3–5-seeded; *pedicel* under fruit much incrassate, 5–8 mm. long and 1·5–3 mm. thick, rugose; calyx usually not persistent in fruit. *Seeds* semi-circular-elliptic, compressed, 15–18 mm. long, 9–12 mm. wide and 5–6 mm. thick in centre, keeled and curved at the back, almost straight at the ventral side with a long narrow, linear scar occupying nearly the whole length of the seed; testa hard, shiny as if polished, bright yellowish-brown when dry.

Natal.—Durban: Berea, *Franks* in herb. Wood No. 11636 (NH, holo.! PRE, BOL, isos!): Durban; *Bayer* 14485. Eshowe: *Gerstner* 2071 (NH), 2546 (NH, PRE, BOL), *Lawn* 202 (NH); *Kotze* 34 = F.D. herb. No. 3178 (SAFD). Ingwavuma: *Bayer* s.n. (NH. No. 31432). Ngoya Forest: *Mehliss* FD No. 2686 (SAFD).

SWAZILAND: *N.N.* in Forestry Herb. No. 5328 (PRE); Hlatikulu, *Boocock* 31 = FD herb. No. 2686 (SAFD).

PORTUGUESE E. AFRICA.—Sul do Save: *Gomes e Sousa* 1648 (COI, PRE).

C. viridifolium belongs to the subgenus *Donella* and is closely related to a number of African species of this section. From *C. pruniforme* Engl. (Mon. Sapot. Afr. p. 42, Fig. A) it differs in the shape of the fruit and the shorter seeds. *C. welwitschii* Engl. (op. cit., 41, t. 13, Fig. A) is a climbing shrub (Angola, West Tropical Africa) and differs also in the shape of the fruit and the nervation of the leaves (in COI represented by: *Welwitsch* 4830, 4831, *Gossweiler* s.n. from Lunda, Saurimo and *Gossweiler* 1644, 4439, 4852, 5011, 6908, 8048).

C. bangweolense R. E. Fries in Schwed. Rhodesia—Kongo exp. 1: 254 (1914) (not seen) is, judging by the description, very closely related to *C. viridifolium* if not conspecific and occurs in Rhodesia. *C. pentagonocarpum* Engl. et Krause in Engl. Bot. Jahrb. 49: 387, Fig. 2 (1913) differs in the size of the fruits and seeds (E. Africa).

2. **Chrysophyllum gorungosanum** *Engl.*, Mon. Sapot. Afr. 8: 44; (1904) Brenan in Mem. New York Bot. Gard. 8 (5): 498 (1954). Type: *R. de Carvalho* s.n. from Gorungosa in COI, lecto!, B, destroyed. *C. fulvum* S. Moore in J. Linn. Soc. Bot. 40: 13 (1911–1912); Type: *Swynnerton* 19 from Chirinda forest, Southern Rhodesia, in BM, not seen, duplicate in SRGH!

A large tree, up to at least 50 m. high, with characteristic fluted bole. *Buds* and *young branches* rufo-tomentose, young leaves silvery-strigose above and silvery-tomentose beneath. *Branchlets* terete, glabrescent, densely leafy. *Leaves* on flowering branches 6–15 cm. more rarely up to 20 cm. long and 2·5–3·5, rarely up to 6 cm. wide, on a 7–16 mm. long petiole; those on sterile branches larger, up to 30 cm. long and 9 cm. wide on a 12–28 mm. long petiole; blade lanceolate-oblong to oblong-oblanceolate or (ob) lanceolate, cuspidate-acuminate (the acumen itself obtuse or subacute), narrowed and acute or sometimes cuneate at base, coriaceous, very soon glabrous and green above, densely rusty-tomentose beneath (or more greyish-tomentose when old); midrib impressed above, very prominent below; secondary nerves 12-17 on either side, impressed above, very prominent below, 5–7 mm., more rarely up to 14 mm., apart, parallel, patent, ascending and becoming inconspicuous well within the margin; tertiary nerves hidden by the tomentum beneath but usually distinct above, ± perpendicular to the main nerve and usually ± parallel, connecting the secondary nerves at an angle between 60° and 90°; ultimate nervation fine, areolate. *Petioles* terete, narrowly sulcate above, finely ferrugineo-pubescent or tomentose, 7–20 (–28) mm. long. *Stipules O. Flowers* in the leaf axils or on the naked branches below the leaves in, sometimes very dense, clusters, or a few of them solitary. *Bracts O. Pedicels* 1–3 mm. long, rather thick, shiny rusty-tomentose; some flowers almost sessile. *Sepals* almost completely free, broadly ovate, obtuse or very obtuse sometimes one of the outer ones subacute, very concave, more or less unequal, ± 3·5 mm. long; the inner ones pale yellowish-brown strigose outside and thinner in texture than the coriaceous rusty-tomentose outer ones; all sepals densely pale fulvo-strigose inside, the inner ones ciliate on one side or all round. *Corolla* white, ± 4 mm. long, the tube cylindric-inflated, slightly longer or about as long as the lobes and ± 3 mm. in diam., the lobes more or less erect and concave, obovate, ovate or subrotundate, obtuse or very obtuse, sometimes with nearly straight truncate apical edge, about 1·5 × 1·5 mm., densely ciliate-barbellate. *Stamens* inserted in the lower half of the corolla tube; filaments about 1·5 mm. long; anthers subsagittate, shortly apiculate, about 1 mm. long. *Ovary* globose, densely hirsute, about 2 mm. in diam., slightly longer than the glabrous, cylindric, truncate style; ovules with baso-lateral attachment. *Berry* globose, sometimes somewhat apiculate, finely pubescent, up to about 3·5 cm. in diam., 4–5 seeded. *Seeds*

19–21 mm. long, 11–12 mm. wide and 5–6 mm. thick in the middle, brown, ovate-oblong, slightly attenuate and subacute at the base; the scar 12–14 mm. long and 1–2 mm. wide at the widest place.

PORTUGUESE E. AFRICA.—Gorungosa: *Rodrigues de Carvalho* s.n. (COI, lecto)!.

SOUTHERN RHODESIA.—Chipinga: Silinda, Chirida forest, *Swynnerton* 19 (SRGH: duplicate of type of *C. fulvum* S. Moore); *Obermeyer* 2161 (PRE, BOL); *Hack* 151/50, *Whellan* 163, *McGregor* 17/48, *Wild* 2096, 2245, *Chase* 620 (all in SRGH); *Vári* 1826, 1865 (PRE). *Jack* s.n. (SRGH, herb. No. 6355); *Chase* 427 and s.n. (SRGH, herb., No. 19262 and 19263); *Fisher* 1223 (PRE); photo of fluted bole of specimen by *N. C. Chase* in SRGH. "Eastern Border": *Chorley* s.n. (SRGH No. 6686). Melsetter: *Eyles* 5721 (SRGH), *Jack* s.n. (SRGH No. 5962). Umtali: *Eyles* 5533 (SRGH).

NYASALAND.—Kota-kota Distr.: Nchisi Mountain, *Brass* 17067 (SRGH).

KENYA.—S. of Mt. Kenya; *Hockliffe* 1370 (PRE).

The type gathering of *Chrysophyllum gorungosanum* Engl. is sterile. As the material in Berlin was destroyed and Engler (l.c.) cited both "Herb. Coimbra" and "Herb Berlin", the material in COI is taken as the lectotype. The type material consists of coppice shoots which are a perfect match of coppice shoots of specimens from the type locality of *Chrysophyllum fulvum* S. Moore from Rhodesia (such as *Obermeyer* 2161). In addition, the only true *Chrysophyllum* of the section *Gambeya* found in the area near the type locality is *C. fulvum* S. Moore (Gorungosa is the region bordering Chipinga and Melsetter in S. Rhodesia), so that there is very little doubt that these two names are synonyms.

Excluded species:

Chrysophyllum magalismontanum Sond. = *Pouteria magalismontana* (Sond.) A. Meeuse, see p. 335.

Chrysophyllum natalense Sond. = *Pouteria natalensis* (Sond.) A. Meeuse, see p. 339.

Chrysophyllum wilmsii Engl. = *Pouteria magalismontana.*

EXPLANATION OF FIGURES.

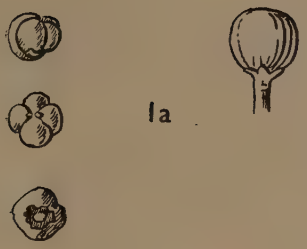
FIG. 1.—*Sideroxylon inerme*, seed and fruit (the seed seen from the side, the top and the base): (*a*) From a specimen *Kotze* 452 (from Amanzimtoti, Natal), (*b*) From a specimen *Galpin* 2468 (from Stutterheim, E. Cape). (All figures if not otherwise stated, natural size).

FIG. 2.—*Chrysophyllum viridifolium*, seed and fruit (from *Gerstner* 2546 Eshowe, Zululand). In this figure, and in all subsequent figures of seeds, the seed is shown from the lateral side and from the ventral side.

FIG. 3.—*Chrysophyllum gorungosanum*, seed and fruit (from *Obermeyer* 2161, Chipinga, S. Rh., in PRE).

FIG. 4.—*Pouteria magalismontana*, seed and fruit (from *Gerstner* 5728, Louis Trichardt, N. Transvaal). (In the lateral view a part of the testa has been removed).

FIG. 6.—*Pouteria natalensis*, seed and fruit (from *Lawn* 57, Eshowe, Zululand).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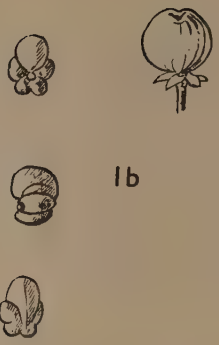
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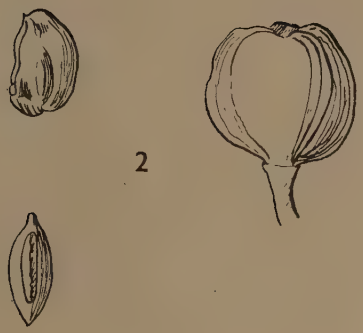
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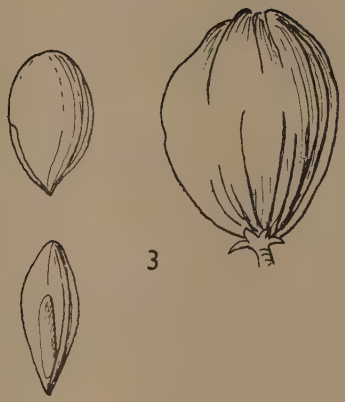
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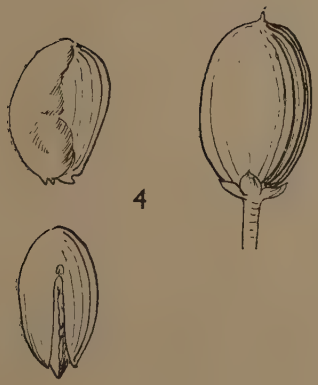
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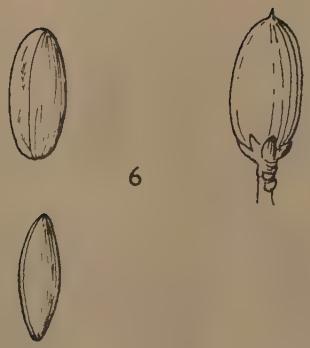

6

3. POUTERIA

Aubl., Hist. Pl. Guiane Fr. 1: 85 (1775); Eyma in Rec. Trav. Bot. Néerl. 33: 159 (1936); Baehni in Candollea 9: 149, pro parte; Herrmann-Erlee & Royen in Blumea 8: 453 (1957).

Lucuma Molina, Saggia Chil. 186 (1782).
Sersalisia R. Br. Prodr. 529 (1810), p.p., as to type species.
Zeyherella Pierre ex Baill., Hist. d. Pl. 11: nota 3 (1892), nomen nudum.
Pachystela Pierre ex Engl., Mon. Sapot. Afr. 35 (1904).
Chrysophyllum L. sect. *Zeyherella* (Pierre ex) Engl. op. cit., 47.
Breviea Aubr. et Pellegr. in Bull. Soc. Bot. France 81: 792 (1934).
Aningeria Aubr. et Pellegr., op. cit., 795.
Chrysophyllum Auct. et *Sideroxylon* Auct., ex parte.

Type species: *P. guyanensis* Aubl. (South America).

Trees or shrubs. *Branches* terete, the young ones often tomentose. *Leaves* varying from papyraceous to coriaceous, exstipulate or occasionally stipulate, often crowded towards the tips of the branches; often hairy on both sides or the lower side, usually more or less glabrescent but rarely ultimately or initially quite glabrous; secondary nerves as a rule distinctly stronger than tertiary ones; tertiary nervation mutually parallel or reticulate, parallel with or more or less perpendicular to secondary nerves; petioles usually distinct; stipules, if present, subulate or setaceous. *Flowers* fasciculate in axils of leaves or leaf-scars, sometimes inserted on brachyblasts (raised warts, etc.), rarely solitary, pedicelled or sometimes sessile; 2–4 bracteoles sometimes present. *Sepals* generally 5, occasionally 4 or 6 in a single whorl, connate at the base only, subequal or more or less unequal (innermost narrower), deciduous or persistent in fruit. *Corolla* exserted, sometimes only a little so, tubular to campanulate; lobes 5 (occasionally 4 or 6–8), more or less erect to somewhat spreading but never reflexed; the tube short but distinct to occassionally rather long. *Alternipetalous staminodes* generally 5, but sometimes fewer, or absent, occassionally 6-8, generally lanceolate or subulate, but sometimes squamiform or larger and petaloid. *Stamens* 5 (occasionally 4 or 6–8), inserted in or near the throat of the corolla. *Ovary* generally 5-loculated, sometimes with a subcupular disc, more or less conical, gradually contracted into the, usually short, cylindric or subulate style. *Fruits* 1-5-seeded but often only 1 or 2 seeds develop in many species; pericarp various but rarely hard. *Seeds* with a thin or sometimes rather thick, often brittle, crustaceous testa and a large to very large cicatrix covering the ventral half of the seed or more, sometimes cicatrix smaller, linear or oblong; cotyledons thick and fleshy; endosperm absent or present as a thin membranous layer.

The delimitation of this genus, as given here, agrees with the circumscription of Herrmann-Erlee and Van Royen (l.c.), except in one character: I include some species with more or less persistent stipules, whereas the Leiden authors state: " Leaves . . . exstipulate ". As the leaves of Sapotaceae are in principle all stipulate, but apparently often exstipulate because the stipules are so early deciduous, I cannot accept the presence or absence of stipules in this family as a very important generic character.

This delimitation agrees also very well with Eyma's conception of the genus based on a study of South American species. As circumscribed here there are about 150 species, in tropical and subtropical America, Africa, Asia, Australasia and the South-West Pacific region.

The genus, as defined here, is considerably smaller than Baehni's enormous genus *Pouteria* of 300–500 species, which includes forms with and without endosperm and with an enormous variation in the characters of the corolla, the stamens, etc. Mr. J. P. H. Brenan of Kew criticized Baehni's very broad generic limits of *Pouteria* in

Mem. New York Bot. Gardens 8 (5): 499 (1954) as follows: " In rejecting Baehni's wholesale amalgamation of African sapotaceous genera under *Pouteria* Aubl., I recognise that the delimitation of genera in this family is often fiendishly difficult and very much a matter of opinion. But at the same time I remain unconvinced that the proposed fusion is going to clear the air and make identification easier ". This statement expresses aptly the opinion of other modern authors. Van Royen has especially critisized the " amalgamation " of species without endosperm (which he retains in *Pouteria* if not referred to different genera for other reasons) and those with copious endosperm (referred to *Xantholis* Rafin. and *Planchonella* Pierre), see Blumea 8: 238–239. Dr. Van Royen kindly pointed out to me that at least some of the African species included by Baehni in his large genus *Pouteria* are indeed *Pouteria* sensu Van Royen, but apparently *Planchonella* does not occur in Africa. My studies, limited as they are, confirm this conclusion. (1)

As far as the African sapotaceous genera are concerned, the species to be included in *Pouteria* sensu mihi are sharply distinghuished from the genus *Chrysophyllum* sensu mihi in that they have usually alternipetalous staminodes and seeds with a thin testa, a broad ventral scar and no endosperm, whereas the other genus lacks alternipetalous staminodes and has seeds with a hard thick testa, a narrow ventral scar and copious endosperm. This implies that several species at one time under *Chrysophyllum* have to be transferred to *Pouteria*.

On the other hand, there are some African genera included in *Pouteria* by Baehni which, although they have the same type of fruit and seed, (i.e. thin testa, large scar, no endosperm) to my mind, do not belong here because they differ in other respects. *Vincentella* Pierre with its totally reflected corolla-lobes, very short corolla-tube, long and capillary stamens, is clearly distinct and is retained. Mr. Brenan independently came to the same conclusion. The genus *Synsepalum* A. DC. of tropical West Africa may also have to be retained on account of the strongly gamosepalous calyx.

It is difficult to say how many species of *Pouteria* sensu mihi there are in Africa, because I have studied only a few representatives and there are probably more. A count of Baehni's species (African) under *Pouteria*, omitting those belonging to *Vincentella* and *Synsepalum*, and including some which Baehni refers to *Chrysophyllum* but are better placed in *Pouteria*, shows a total of about 20 African species probably to be retained in *Pouteria*.

Leaves with secondary veins 1–3 cm. apart and very prominent on lower surface.... 1. *P. brevipes.*

Leaves with secondary veins much closer (several per cm.) and not very prominent:

Leaves usually rounded or emarginate at the apex, usually rusty-tomentose rarely more silvery, on lower surface; flowers fasciculate or solitary, often on raised warts on the naked branches below the leaves; pedicels and calyx rusty-pubescent ..... 2. *P. magalismontana.*

Leaves usually bluntly acuminate at the apex, usually silvery-white on lower surface; flowers solitary or 2–3 together sessile in the leaf-axils, calyx with a dark tobacco-brown pubescence..... 3. *P. natalensis.*

1. **P. brevipes** (*Baker*) *Baehni* in Candollea 9: 290 (1942); (for full synonymy see Baehni). *Sideroxylon brevipes* Baker in Oliv., Fl. Trop. Afr. 3: 502 (1877), type: *Kirk* s.n. in K, from Zanguebar.

(1) Note added in proof: Aubréville and Pellegrin in Bull. Soc. Bot. France 105: 37 (1958) raised Engler's section *Zeyherella* to generic rank (including only *Chrysophyllum magalismontanum* Sond.) and described a genus *Boivinella* with 5 species including *Chrysophyllum argyrophyllum* Hiern, *C. wilmsii* Engl. and *C. natalense* Sond. The first two I consider to be taxonomical synonyms of *C. magalismontanum* (*Pouteria magalismontana*, see p. 335), which these authors place in a different genus (*Zeyherella*)! This is an example of the other extreme, viz., excessive splitting of genera, resulting in the creation of a number of (to my mind, unnecessary) synonyms and adding to the confusion instead of clearing up the generic delimitations in the African Sapotaceae.

Pachystela brevipes (Baker) Baill. in Bull. Soc Linn. Paris 11: 947 (1891), *nomen nudum*. *P. brevipes* (Baker) Engl., Mon. Sapot. Afr. 37 (1904). *P. cinerea* (Engl.) Pierre ex Engl., op cit., 36, t. 12, incl. vars.; type: *Welwitsch* 4824 in B†, isotype BM, type number COI!

Bakeriella brevipes (Baker) Dubard and *B. cinerea* (Engl.) Dub. in Ann. Mus. Col. Marseille 20: 27 (1912).

A tree reaching a height of at least 10–15 m. *Branches* rather thick, at first thinly pubescent or thinly brownish-tomentose, glabrescent, later longitudinally fissured and often turning ashy-gray or almost white. *Stipules* coriaceous, linear-subulate, 5–15 mm. long, brown rusty-pubescent or glabrous, very acute. *Petioles* stoutish, 5–10 (–15) mm. long, 2–4 mm. thick, flat above, when dry longitudinally sulcate. *Leaves* lanceolate-oblong or oblong-oblanceolate to obovate-oblong, 5–20 cm. long and 2–8 cm. wide, coriaceous, shiny and glabrous above, much paler and dull, shortly whitish-tomentose or glabrous below, with obtuse or shortly and bluntly acuminate apex and narrow, cuneate or decurrent-attenuate base, and revolute edge; midrib impressed and distinctly keeled above, prominent and when dry longitudinally fissured below; lateral veins 8–10 on either side, distant (1–3 cm. apart), arcuate-ascending, impressed above, very prominent below, all reaching the edge of the leaf or nearly so; ultimate nervation coarsely reticulate mainly more or less perpendicular to the midrib; veinlets very delicate and inconspicuous. *Pedicels* short and thick, ± 3 mm. long and 1–2 mm. in diam., covered with a pale fawn tomentum. *Flowers* clustered in the axils of the lowermost leaves or on the naked wood below the leaves on raised warts, sweet-scented. *Sepals* ovate-oblong, oblong or oblong-lanceolate (the inner ones narrower), 3·5–4·5 mm. long and 1·5–3 mm. wide, subacute or obtuse, more or less concave, pale fawny-tomentose outside and inside. *Corolla* glabrous; the tube ± 2 mm. long and 1–1·5 mm. in diam.; the lobes oblong or ovate-oblong, subacute or obtuse ± 4 mm. long and 1·5-2·25 mm. wide. *Alternipetalous staminodes* glabrous, lanceolate-linear, linear-subulate, or filiform, acute, acuminate and often lacerate or incised-dentate (the filiform ones not infrequently with a terminal thickening or even a small sterile anther), usually shorter than the filaments, but occasionally equalling the stamens, sometimes small, squamiform or O. *Filaments* linear-filiform, 3–4 mm. long; anthers pink (Mrs. Faulkner), 2–2·5 mm. long. *Ovary* ovoid, ± 2 mm. long and 1·5 mm. in diam., distinctly 5-lobed-sulcate below, densely fulvo-villous, situated on a flat disc; style thick, columnar, angular, widened, subcapitate-truncate and indistinctly 5-lobed at the apex, 4–5 mm. long, covered with long hairs at the base or sometimes half way up. *Fruiting pedicels* hardly changing but more or less glabrescent; the calyx persistent, ± spreading but not reflexed. *Fruit* edible, yellow when ripe, ellipsoid, 15–22 mm. long and 9–12 mm. in diam. *Seed* the same shape as the fruit but smaller, 12–16 mm. long and 6–9 mm. in diam., scar occupying more than half the surface of the seed; testa smooth and shiny light brown, the scar duller and paler, somewhat rough.

FIG. 5.—*Pouteria brevipes*, seed and fruit (from *Zenker* 4324, Cameroons, in PRE).

Widespread in tropical Africa, but not recorded from Northern Rhodesia. I have seen numerous specimens from tropical East and West Africa in several herbaria and only cite those occuring in Southern Africa:

PORTUGUESE EAST AFRICA.—Manica e Sofala; Chipinga, Busi Drift (East of Melsetter, S. Rhodesia), *Whellan* 133 (SRGH). Maribane, *Gomes Pedro* 4193 (LMJ, PRE); " Na floresta de Maronga ", *Simão* 375 (LM); Matarara do Lucite, *Gomes Pedro* 4278 (LMJ, PRE). Zambezia: Quelimane Distr., Metola, *Barbosa & Carvalho* 4002 (LM, PRE), between Mualama and Gilé, *Barbosa & Carvalho* 4342 (PRE); Mocuba, *Faulkner* " Kew 18 " (PRE, SRGH, COI). Niassa: Nampula, Nova Chaves, *Barbosa & Lemos* 1780 (LM); Pto. Amelia, Mueda, *Barbosa* 2238A (LM, PRE); between Mueda and Chomba *Barbosa* 2248 (LM).

SOUTHERN RHODESIA.—Vumba: Wychwood, *Ball* 14 (SRGH, PRE). Melsetter: between Hayfield and Lusitu river/Haroni, *Drummond* 5001 (SRGH, PRE).

ANGOLA.—Cuanza: Golungo Alto, between Cambondo and Luinha River, *Welwitsch* 4818 (COI); Pungo Andongo: *Welwitsch* 4824 (COI; type number of *Pachystela cinerea*); Calemba Island in Cuanza Riv., *Welwitsch* 4826 (COI); Ponta Filomene de Camera, nr. Cuanza Riv., *Gossweiler* 10649 (COI).

As regards the author of the combination " *Pachystela brevipes* ", the genus *Pachystela* was only validly described in 1904, so that Baillon's name " *Pachystela brevipes* (Baker) Baillon ", published in 1891, is a nomen nudum and " *Pachystela brevipes* (Baker) Engl." is the correct citation under the Rules.

2. **P. magalismontana** (*Sond.*) *A. Meeuse*, comb. nov.

Chrysophyllum magalismontanum Sond. in Linnaea 23: 72 (1850) (sphalm. " *magalismontana* "); Engl., Mon. Sapot. Afr. 47 t. 16, f. C (1904); Wright in Dyer, Fl. Cap. 4, 1: 437 (1906); Phillips in Flow. Pl. S. Afr. 3, t. 98 (1923); Marloth, Fl. S. Afr. 3: 36, t. 10 (1932); Gerstner in J. S. Afr. Bot. 12: 40, Fig. 4 (1946), and 14: 171, Figs. A–F (1948); Brenan in Mem. New York Bot. Card. 8 (5): 498 (1954); type: *Zeyher* 1849 from Magaliesberg, Transvaal in herb. Sonder nunc S, holo, BOL and SAM, isos!). *C. argyrophyllum* Hiern, Catal. Afr. Pl. Welw. 3: 641 (1898); Engl. op. cit., 46, t. 16, Fig. A; Brenan & Greenway, T.T. Check List 2: (1949); type: *Welwitsch* 4827, 4828, 4829, syns. in BM, 4828 in COI!) *C. antunesii* Engl. in Engl. Bot. Jb. 32: 137 (1903); type: *Antunes* 98 (B †, COI, lecto.!). *C. carvalhoi* Eng., op. cit. (1904), 47; type: *Rodrigues de Carvalho* s.n. in COI, lecto!, B †. *C. wilmsii* Engl., op. cit. (1904), 46, t. 16, Fig. B; Wright, op. cit., 437; type: *Wilms* 1812 in B †, holo, K, iso, *C. gossweileri* De Wild., Pl. Bequart. 4: 130 (1926); type: *Gossweiler* 2808 in BR, dupl. in COI!

Sideroxylon randii Sp. Moore in J. Bot. 41: 402 (1903); Wright, op. cit. 439; type: *Rand* 1017 from Johannesburg, BM, holo.; photo in J!.

Pachystela magalismontana (Sond.) H. Lec. in Bull. Mus. Hist. Nat. Paris 25: 192 (1919). *P. argyrophylla* (Hiern) H. Lec., l.c.

A large tree when growing in forests (up to at least 15 m. high), but in its more characteristic form, growing on stony koppies and rocky ledges in the Transvaal, a shrub, already flowering and fruiting freely when only about 1 m. high. *Leaf-bearing branches*, especially in the shrubby form, often stout, 5–10 mm. thick, with short internodes. *Innovations* and *twigs* rufo-tomentose. *Leaves* often near apex of otherwise leafless branches, stipulate and sometimes thinly papyraceous when young, coriaceous when mature, first with a white bloom but soon glabrous and green above, rufo- or aureo-tomentose (older ones often more greyish- or silvery-tomentose, sometimes with a pale pink or mauve tinge) below, 4–15 cm., sometimes up to 30 cm. long, 2–5 cm., sometimes up to 7 cm., wide, those of the characteristic shrubby form usually deflexed, rather small (up to 12 cm. long and 5 cm. wide), oblong-obovate, obovate-elliptic or oblong, usually

rounded or slightly narrowed at the base, rarely obovate with cuneate base; emarginate, retuse or at least obtuse at the apex, sometimes mucronate with short, often blackish, mucro, sometimes more strongly tapering at the base and oblanceolate-oblong; petiole 6–12 mm. long; those of the forest form usually distinctly cuneate at the base, lanceolate, oblong or oblanceolate-oblong to oblanceolate-cuneate, occasionally (on coppice shoots) up to nearly 30 cm. long and 7 cm. wide on a longer (up to 24 mm. long) petiole, but usually smaller, with obtuse, rounded, emarginate or retuse, sometimes shortly and bluntly acuminate, occasionally mucronate apex; midrib immersed and narrow canaliculate above, very prominent below; secondary nerves numerous (6–7 per cm.), slender, usually inconspicuous above, partly hidden under the tomentum, but on the older leaves often loosing their pubescence and becoming slightly prominent beneath, patent, straight, but distinctly ascending and curved towards the margin, sometimes joining and forming an irregularly sinuous, often very inconspicuous intramarginal vein, more rarely bifurcate and archingly joining; tertiary nerves parallel to and thinner than secondary ones, somewhat sinuous, mostly not reaching the margin without branching or joining other veins, often inconspicuous; ultimate reticulate nervation usually sparse, inconspicuous, mainly present towards the margin and ⊥ parallel to secondary and tertiary nerves. *Petioles* thick, subterete but often longitudinally ribbed or angled, at least when dry, rusty- or aureo-pubescent, later sometimes ashy-grey-pubescent on a brown background. *Stipules* long-subulate, often curved, pubescent, soon deciduous. *Flowers* in few- to many-flowered, sometimes very dense, fascicles, the majority usually on the lower leaflets parts of the branches or on older wood on sometimes rather large, raised warts, and fewer, or none, in the leaf axils. *Bracts* O or very minute. *Pedicels* densely rufo-tomentose, varying in length from ± 2 mm. to ± 5 mm., more rarely up to ± 10 mm. long, rather stout and gradually or more abruptly widening at the top into the calyx; rarely flowers sessile. *Calyx* 2·5–4 (–5) mm. long, rufo-tomentose outside; sepals free nearly to the base, often unequal, ovate, obtuse or subacute, often greyish-pubescent inside, 2–4·5 mm. long and 2–3·5 mm. wide. *Corolla* white or whitish, turning brown (according to the labels also " pink " or " red " in Rhodesia and East Africa, but this may refer to already wilted flowers), glabrous, varying in length from scarcely longer than to about 2 mm. longer than the calyx; tube cylindric-urceolate, usually 1–1·5 mm. sometimes up to 2 mm., rarely only about 0.5 mm. long; the lobes somewhat to distinctly spreading, broadly ovate, obtuse or subacute, 2–4·5 mm. long and about 2 mm. wide. *Alternipetalous staminodes* O or sometimes 1–5, inserted just below the sinuses between the corolla-lobes, much smaller than the latter, scale-like and minute or sometimes petaloid, ovate or suborbicular, more or less irregularly serrate, dentate or incised in the supper half, up to 1·5 mm. long and 0·5-1 mm. wide. *Stamens* subincluded, inserted at the base of the corolla-lobes; filaments 1·5–2 mm. long; anthers 1–2 mm. long, somewhat cordate-sagittate at the base before dehiscence, acute, apiculate; sometimes stamens sterile, staminodial, either resembling a stamen with a filament-like basal portion and a sagittate-cordate, broader top which often shows two longitudinal marks (cf. Gerstner, 1948, Figs. A–F), or more irregularly shaped, very rarely (fide Engler, op. cit., 47, t. 16, Fig C, and c) lanceolate, petaloid. *Ovary* globose-ovoid, about 2 mm. in diam., densely villous, 5-, sometimes 3- or 4-celled, gradually passing into the ⊥ 1·5 mm. long, glabrous style. *Fruit* ellipsoid, ± 25 mm. long ⊥ 18 mm. wide, dark red when ripe, edible, crowned with the persistent style, 1- or sometimes 2-seeded. *Seeds* of 1-seeded fruits compressed -ovoid, 16–20 mm. long, 14–16 mm. broad and 8–11 mm. thick; those of 2-seeded fruits with one flattened lateral side; testa light brown, shiny, thin and brittle when dry; scar linear-triangular, ventral, occupying about ¾ of the length of the seed; 2 mm. wide or more in widest place.

General Distribution.—Tropical Africa, from the Congo to Tanganyika and southwards to Angola, Bechuanaland, the Transvaal, Swaziland and Natal. At least in the Transvaal this species is apparently confined to quartzite and granite rocks, so that the

plant is as much an indication of the formations as the formations are an indication of the occurence of *P. magalismontana*. In N. Zululand, for instance, where quartzite rocks occur locally, *P. magalismontana* is only found in the area where the rocks come to the surface.

Selected citations;

BECHUANALAND.—Kanye: *Hillary & Robertson* 613; Lobatsi Govt. Farm: *Miller* B/246.

TRANSVAAL.—Zoutpansberg: Louis Trichardt, Hanglip, *Gerstner* 5728. Sebasa: near Sebasa, *Codd & Dyer* 4515. Pietersburg: Woodbush, *Hoffmann* 22. Warmbaths: Warmbaths. *Leendertz* s.n., *Burtt Davy* 2616, *Hutchinson* 1883. Brits: Silkaatsnek, *Smuts & Gillett* 1061. Magaliesberg Range: *Zeyher* 1849 (BOL, SAM, type gathering); *Burke* 377 (" twin type ", BOL). Pretoria: Pretoria, *Leendertz* 322, 510; *Burtt Davy* 2675, *Pole Evans* 30, 161; Hutchinson 2314. Nelspruit: Kruger National Park, *v. d. Schijff* 59, *Codd* 5745. Barberton: *Burtt Davy*, 258. Marico: Zeerust, *Gerstner* 4413 (NH). Rustenburg: *Leendertz* s.n., *Pegler* 1033. Witwatersrand: Johannesburg, *Rand* 1017 (PRE, fragment of type of *Sideroxylon randii*); *Gerstner* 6418, 6424; *English* in Herb. Galpin 1486. Heidelberg: *Leendertz* s.n. (TRV. No. 8077); Delmas: *Naude* s.n. Brits: Silkatsnek, *Smuts & Gillett* 1061; Hartebeespoort, *Prosser* 1297 (NBG). Magaliesberg Range: *Zeyher* 1849 (BOL, SAM, type gathering); *Burke* 377 (BOL). Pretoria: Pretoria, *Leendertz* 322, 510; *Burtt Davy* 2675; *Pole Evans* 30, 161; *Hutchinson* 2314.

SWAZILAND.—*Codd* 1585; *Acocks* 12850; *Miller S*/108; *Bolus* H. No. 12110 (BOL).

NATAL AND ZULULAND.—Ngotshe: Magut, Pongola, *Gerstner* 2461; Ngome Forest Stat., *Tustin* = FD herb. No. 6552.

PORTUGUESE E. AFRICA.—Manica e Sofala: " Floresta do Garuso ", *Simão* 552 (PRE: with lanceolate, petaloid epipetalous staminodes instead of stamens); Chimanimani Mts., *Plowes* 1250 (SRGH); Gorungosa, Rodrigues de Carvalho s.n. (COI, sterile branch, type of *Chrysophyllum carvalhoi* Engl.).

There has been some misunderstanding as regards the occurrence of the reduced sterile flowers and their proper significance. Sonder described *Chrysophyllum magalismontanum* as having normal stamens, citing *Zeyher* 1849 as the type number. Engler (1904) described *C. magalismonatum* as having female flowers with lanceolate epipetalous staminodes and oblong leaves (he cites *Zeyher* 1849 and *Burke*) and distinguished *C. wilmsii*, which is described as having leaves that are much narrowed at the base, and fertile anthers. Wright (in Fl. Cap. 4, 1: 437) distinguished these two as follows:

Leaves oblong, obtuse, obtuse at the base; flowers pedicellate..... *magalismont anum*
Leaves oblong, obtuse, mucronulate, acute at the base, flowers shortly pedicellate..... *W ilmsii*

Wright made no mention of staminodes, but also cited *Zeyher* 1849 and *Burke* 377 under *C. magalismonatum*.

Gerstner identified the form with sterile anthers with *C. wilmsii* Engl., which is not correct, but he discovered that *C. magalismonatum* under unfavourable conditions produces depauperate flowers (*Gerstner*, op. cit. 1948, p. 171), especially after a severe drought of several months. As soon as sufficient rain has fallen the same plants develop complete flowers. The sterile stamens are sometimes transformed into lanceolate epipetalous staminodes (e.g., in *Simão* 552 and in a specimen leg. N.N. from Bulawayo = SRGH No. 5579), and the specimen *Zeyher* 1849 in the Berlin Herbarium studied by Engler is probably a branch with such abnormal flowers, whereas other specimens of the gathering *Zeyher* 1849 such as those in BOL! and SAM! (taken from other branches or other trees ?) bear normal flowers and this explains the apparent controversy. I have also found that fertile and sterile stamens can occur in one flower, and

these sterile anthers, sometimes appearing as subpetaloid epipetalous staminodes are clearly abnormal, at any rate they have no taxonomic value. The difference in leaf shape as indicated in Fl. Cap. breaks down altogether as a character and *C. magalismontanum* and *C. wilmsii* are clearly synonomous.

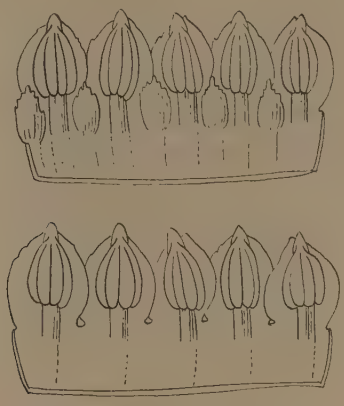


FIG. 7.—*Pouteria magalismontana*, opened corolla-tubes of two flowers of *Gerstner* 6418 (from Johannesburg, Transvaal), x 5, seen from the inside. Above: flower with 5 developed alternipetalous staminodes, below: flower without staminodes.

The presence or absence of alternipetalous staminodes is independent of the degree of development of the stamens and they also occur in flowers of Gerstner's forma *depauperata* (such as those of the specimen *Gerstner* 6424 cited by him). These alternipetalous staminodes are by no means rare: if sufficient flowers of a single specimen are dissected, some flowers with 1–5 staminodes (at least one in 10) are found. However, some specimens (or perhaps some individual plants) show a much higher frequency of flowers with developed staminodes of this type, such as *Gerstner* 6418 in which the majority (over 60%) of the flowers possess petaloid staminodes (see Fig. 7). Moore's type specimen of *Sideroxylon randii* (*Rand* 1017 in BM) is obviously such a special case. In every other respect, the description of *S. randii* and a photo of the type specimen (in J) agree perfectly with *C. magalismontanum*. Mr. de Winter, who examined the type specimen, confirmed my opinion and sent one flower of *Rand* 1017 which proved to be identical with *P. magalismontana*, so that *S. randii* falls into synonymy. This is a good example of the unreliability of the absence or presence of alternipetalous staminodes as a main distinguishing character in this family. Moore, after observing distinct staminodes, made it a *Sideroxylon*, whereas Sonder and Engler, who did not see distinct staminodes, referred the same species, apparently without any doubt, to *Chrysophyllum*.

As regards the identity of *P. magalismontana* and *Chrysophyllum argyrophyllum* Hiern, the differences indicated by Engler in his monograph are very slight. The differences reported are: (1) colour of the lower leaf surface (rusty-tomentose in *magalismontanum*, grey or silvery in *argyrophyllum*); (2) leaf shape (oblong to obovate-oblong in the first, oblanceolate (ioblong) in the second); (3) petioles, pedicels and calyx rusty-tomentose in the first, greyish-pilose in the second. These differences are not important, because the pubescence may be rusty- or greyish-tomentose on various parts of the same specimen, older parts tending to change from rusty-brown into grey and the leaf-shape varies even in one of the original gatherings cited by Hiern: *Welwitsch* 4828

(in COI!). I have seen many specimens from Angola, Rhodesia and East Africa and there is no sharp distinction between those referred to *C. argyrophyllum* in various herbaria and those referred to *C. magalismontanum*.

The species under discussion was redescribed several times again: *Chrysophyllum antunesii* Engl. and *C. gossweileri* De Wild. are small-leaved forms from Angola (I have seen types or isotypes of these in COI); *C. carvalhoi* Engl. is a form with narrow, lanceolate and acuminate leaves, collected in Moçambique (type in COI!).

3. **P. natalensis** (*Sond.*) *A. Meeuse*, comb. nov.

Chrysophyllum natalense Sond. in Linnaea 23: 72 (1850); Engl., Mon. Sapot. Afr. 43, t. 34, Fig. C (1904); Wood, Natal Pl. 4, t. 378 (1906); Wright in Dyer, Fl. Cap. 4, 1: 437 (1906); Sim, For. Fl. Cape Col. 252, t. 94, (1909); Gerstner in J. S. Afr. Bot. 12: 48, Fig. 2 (1946); type: *Gueinzius* 181 from Berea near Durban in herb. Sonder nunc S.

A medium-sized tree, 8–15 m. high, but often fruiting freely without much height, " growing mostly in the open or gregariously " (Sim). *Stem* up to 50 cm. in diam., with smooth bark, according to Sim and Gerstner yielding a valuable timber. *Twigs* slender, terete, grey, glabrescent; internodes decreasing in length towards the apex, so that the leaves are crowded at the tops of the twigs. *Innovations* and calyx densely dark tobacco-brown-tomentose. *Leaves* 6–12 (–15) cm. long and 2–4 (–5) cm. wide, obovate-lanceolate (ob) lanceolate-elliptic or (ob) lanceolate-oblong, shortly acuminate, acute or obtuse, at the very apex canaliculate-subdeflexed, sub-emarginate and mucronulate (occasionally in a few leaves retuse or emarginate), gradually tapering into the acute or somewhat acuminate base, when mature green (drying a characteristic greyish-green), glabrous and very shiny above, very minutely greyish- or silvery-tomentose, later sometimes glabrescent, beneath, with entire, subdeflexed and ± undulate margins; midrib immersed and channelled above, prominent and conspicuous below; secondary nerves thin, raised, about 20 on either side, patent, almost straight, bifurcate usually well within the margin and archingly joining, no distinct intramarginal vein present; teritiary nerves inconspicuous, mostly parallel to secondary ones. *Petioles* 6–12 (-14) mm. long, canaliculate above, often brown or blackish, rugose, with two short dorsal ridges where the slightly decurrent leaf-base ends and there seemingly distinctly narrowing into the leaf-base when seen from above (at least when dry), but in fact continuous with the midrib. *Stipules* wanting or at least very early deciduous. *Flowers* sessile, in clusters of 1–3 (sometimes more) together in the leaf axils; bracts small, inconspicuous, broadly triangular, rusty-pubescent, or wanting. *Calyx* ± 4 mm. long, divided more than half way down, the segments erect, ovate, subacute. *Corolla* " white " or " yellowish ", glabrous; tube somewhat longer than the calyx, more or less constricted above the middle; the lobes suberect, ovate, obtuse, about 1 mm. long. *Anthers* subsessile, inserted at the very base of and about as long as the corolla-lobes, ovate, apiculate, not or scarcely exerted. *Ovary* depressed-globose, more or less 5-lobed, shortly pilose, contracted into the glabrous, obtuse, cylindrical style which is up to about twice as long as the ovary. *Berry* subsessile, cylindrical-ovoid or cylindric-oblong, pointed (more or less shaped like an acorn), crowned with the persistent style, 2–2·5 cm. long and 1–1·5 cm. in diam., deep red when ripe (? also sometimes transparent white, Sim) minutely pubescent, one-seeded, edible. *Seed* ellipsoid-oblong, ± 20 mm. long, ± 8 mm. wide, and ± 5 mm. thick in the centre, with a long ± 2·4 mm. wide scar occupying the whole ventral side of the seed; testa thin, brittle.

Distribution.—In frostless forests in the Eastern Cape Province and Natal, from East London and Komgha northwards, also recorded from the central Transvaal, Portuguese East Africa and the eastern part of Rhodesia, and extending into tropical East Africa as far as Tanganyika or perhaps Uganda.

The type (not seen) is *Gueinzius* 181 from Berea nr. Durban, Natal(in herb. Sonder). This same number is cited by Harvey ex Wright in Fl. Cap. 4, 1: 437, together with *Sanderson* 657, *Wood* 732 and a few other gatherings. Engler (1904) cites *Gueinzius* 181 and *Medley Wood* 8950. The specimen *Wood* 732 and Engler's figure leave no doubt about its identity.

Cape Province.—East London: near East London, *Galpin* 9284 (PRE), 9677 (PRE). Komgha: Flanagan 1138 (GRA, PRE, BOL, SAM). Pondoland: Egossa, *Sim* 2374 (NU, GRA, PRE, BOL, SAM). Kentani: *Pegler* 859 (GRA, PRE, BOL, SAM, NBG); Manubi Forest, *Story* 4475 (PRE). Willowvale: *Acocks* 12284, 12286 (PRE). Ngqeleni: Notinsella, FD herb. No. 1728 (SAFD); Gokama Forest: *Marais* 758. Port St. Johns: *O. B. Miller* D/88 = FD herb. No. 3864 (SAFD); Noxolweni Forest, *Mogg* 13089 (PRE).

Natal.—Umzinto: Dumisa, *Rudatis* 964 (L). Pietermaritzburg: *Killick* 308 (PRE). Durban: *Sanderson* s.n. (= 657?) (PRE), *Wood* s.n. BOL, SAM = prob. Inanda, *Wood* 732, GRA); *Marriott* PS 230 (PRE), *Thorns* s.n. (NH no. 23407), *Lavoipierre* 94 (NU). Eshowe: *Lawn* 57 (NH), *Gerstner* 1920 (NU, PRE), *Forbes* 681 (NH), *Codd* 1860 (PRE). Hlabisa: Hluhluwe Game Reserve, *Codd* 2050, *Ward* 1692 (PRE). "Zululand": *Gerstner* 2618 (BOL).

Transvaal.—Pilgrims Rest: Mariepskop, *Killick & Strey* 2496 (PRE).

Swaziland.—*Miller* S. 263 (PRE).

Tanganyika.—Devern: *Burtt* s.n. (J); Zigigler (or Zigiglen): *Burtt* s.n. (J), East Usambaras: Mlinge-Tongwe: *Greenway* 6064.

Two specimens from Uganda (*Greenway* 6064 and Greenway & Eggeling 7076 in EA and PRE) are very similar if not conspecific. Two species described from E. Africa, viz. *Chrysophyllum holtzii* Engl. et Krause in Engl. Bot. Jahrb. 49: 390 (1913), and *C. tessmannii* Engl. et Krause (op. cit., p. 389) may well be synonyms of *Pouteria natalensis*.

As regards its taxonomical position, Engler placed *P. natalensis* in the subgenus or section *Gambeya* (Pierre) Engl. (= *Afrochrysophyllum* Engl. p.p.) of *Chrysophyllum*, but this species has several features which distinguish it from *Gambeya*: according to Engler's diagnosis of *Gambeya* (Engler, op. cit., p. 43), the stamens are inserted at or below the middle of the corolla-tube ("Staminum filamenta ad basin tubi vel medio libera"), the corolla lobes are ciliate (Corollae tubus *lobis ciliatis* aequalis vel longior") and the nervation of the leaves is different: ("... nervis lateralibus I pluribus numerosis *arcuatim* patentibus prope marginem sursum versis, nervis lateralibus II *inter primarios* obliquis"). The fruit is also different (1-seeded in *P. natalensis*, usually several-seeded in *Gambeya*, the seed-scar occupying the whole ventral side of the seed in *P. natalensis*, only the greater part of the ventral side in *Gambeya*) and, finally the ovules are basolaterally attached in *Gambeya* and distinctly laterally in *P. natalensis*. I cannot refer *P. natalensis* to any other African genus but *Pouteria* on account of the fruit characters (thin testa, large scar and lack of endosperm), in spite of the apparently constant absence of alternipetalous staminodes (which would not, however, exclude it from *Pouteria* sensu Van Royen).

Although most modern authors do not agree with Baehni's very broad conception of the genus *Pouteria*, several tropical species which fall into *Pouteria* sensu Van Royen were either overlooked, or expressly excluded from the genus by Baehni. I cannot see why these species were omitted or excluded, as Baehni did not give any reasons for his actions. It seems necessary to make the recombinations in *Pouteria*, because it may guide future workers on the flora of tropical Africa as regards my conception of the genus. This list is not complete, for only those species are included which could be studied from authentic herbarium specimens or from good plates.

Pouteria adolfi-frederici (*Engl.*) *A. Meeuse*, comb. nov. *Sideroxylon*(?) *Adolfi-frederici* Engl. in Mildbr., Wiss. Ergebn. deut. Zentral-Afr. Exp. 1907–1908, 2: 519, t. 52 (1913). *Aningeria adolfi-frederici* (Engl.) Robyns & Gilbert in Robyns, Fl. Spermatophyt. Nat. Parc Albert 2: 43 (1947).

The plate and a duplicate of a syntype (named by Engler), viz., *Mildbraed* 2528 (PRE), were available for study. There is no doubt that it is a *Pouteria*.

Pouteria cerasifera (*Welw.*) *A. Meeuse*, comb. nov. *Sapota cerasifera* Welw., Apontam, 585, No. 17 (1859). *Chrysophyllum cerasiferum* (Welw.) Hiern, Cat. Afr. Pl. Welw. 3: 643 (1898). *Sersalisia cerasifera* (Welw.) Engl., Mon. Sapot Afr. 30 (1904).

Pouteria disaco (*Hiern.*) *A. Meeuse*, comb. nov. *Chrysophyllum disaco* Hiern, Cat. Afr. Pl. Welw. 3: 642 (1898). *Sersalisia disaco* (Hiern) Engl., Mon. Sapot. Afr. 30, t. 10A (1904).

Mr. B. de Winter compared a few specimens from Portuguese East Africa with authentic material (*Welwitsch* 4812 in BM). Some of these are in fruit and can, therefore, be referred to *Pouteria* sensu Van Royen.

Pouteria msolo (*Engl.*) *A. Meeuse*, comb. nov. *Chrysophyllum msolo* Engl., Pflanzenw. O. Afr. C., 306, t. 37 (1895). *Pachystela msolo* (Engl.) Engl., Mon. Sapot. Afr. 38 (1904).

This plant is so closely related to "*Pachystela brevipes*" that Engler did not hesitate to refer it to *Pachystela* and it is altogether incomprehensible to me how Baehni could exclude *Pachystela msolo* (in Candollea 9: 428), while referring *P. brevipes* to *Pouteria* (op. cit., 291). The same applies to the following species which is also very similar to *P. brevipes* and yet excluded by Baehni (op. cit., 428) from *Pouteria*.

Pouteria zenkeri *A. Meeuse*, nom. nov. *Pachystela robusta* Engl. in Engl. Bot. Jahrb. 49: 386 (1913), non *Pouteria robusta* (Mart. et Eichl.) Eyma.

A true isotype, named by Engler, viz. *Zenker* 3697 (in PRE) was studied. The specific epithet "*robusta*" being preoccupied on account of an earlier combination for an American species, the name "*zenkeri*" was chosen to commemorate its first collector, well-known for his extensive West-African collections. It is strange that no reference is made to this Cameroons species in Hutchinson and Dalziel's Fl. W. Trop. Afr. vol. 2 under Sapotaceae.

4. VINCENTELLA

Pierre, Not. botan. Sapot. 37 (1891). *Bakerisideroxylon* Engl. (as a section of *Sideroxylon*) in Engl. u. Prantl, Natürl. Planzenfam. ed. 1, 4, 1: 144 (1890), and in Nachträge 276 (1897); (as a genus) in Mon. Sapot. Afr. 33 (1904).

Sideroxylon sensu Baker in Oliv., Fl. Trop. Afr. 3: 502 (1877), pro parte.

Bakeriella Dubard in Lecomte, Not. Syst. 11: 89 (1911) and in Ann. Mus. Col. Marseille 20: 26 (1912), pro parte.

Pouteria Aubl. sectio *Bakerisideroxylon* (Engl.) Baehni in Candollea 9: 382 (1942).

Type species: Baehni, in Candollea 7: 497 (1938), p. 497, mentions as the type species *Vincentella longistyla* (Baker) Pierre, Not. Bot. Sapot. (1891), p. 37. However, this is a synonym of *Pachystela brevipes* and as *Pachystela* was only validly published in 1904, *V. longistyla* at the same time being removed from *Vincentella* and transferred to *Pachystela* by Engler, the type species of *Vincentella* must be among the other two species mentioned by Pierre and retained in *Bakerisideroxylon* by Engler, viz., *V. densiflora* (Baker) Pierre and *V. revoluta* (Baker) Pierre. Priority of place would indicate *Sideroxylon densiflorum* Baker = *Vincentella densiflora* (Baker) Pierre (from San Tomé Island) as the type species, as was rightly pointed out by Exell in Cat. Vasc.

Pl. S. Tomé 235 (1944).

Shrubs or trees. *Leaves* generally oblong, with usually rather distant prominent secondary nerves and fine tertiary reticulate nervation. *Stipules* early deciduous. *Flowers* small, 5-merous, in many-flowered fascicles in the leaf axils and especially in the axils of fallen leaves on the twigs; pedicels very slender to capillary often rather long and more or less pendulous. *Sepals* small, free nearly to the base, later patent or reflexed. *Corolla-tube* very short, the lobes many times longer, elongate-oblong or linear-oblong, strongly reflexed. *Staminodes* and *stamens* inserted at the throat of the corolla-tube. *Alternipetalous staminodes* narrowly linear, inserted between and about as long as the corolla-lobes (but erect), entire or rarely dentate-serrate, acute or acuminate. *Filaments* filiform, erect, several times longer than the oblong-sagittate, minutely apiculate anthers. *Ovary* large, ovoid, villous, contracted in the usually rather long and filiform-cylindric, glabrous style, 5-loculated; ovules with lateral attachment, pendulous. *Fruit* oblong-ovoid, 1-seeded with 4 sterile loculi. *Seeds* oblong; testa crustaceous; scar long, linear, occupying the upper part of the ventral side of the seed; cotyledons thick and fleshy, endosperm membranous or absent.

An African genus of four species, on species extending into Southern Africa.

As Baehni, l.c. pointed out, *Vincentella* Pierre (1891) was legitimately published as a genus, although it corresponded with a section *Bakerisideroxylon* (1890) distinguished by Engler in the genus *Sideroxylon* which was later (1904), given the status of a genus by Enger. Pierre was not compelled to take up Engler's section name when he established a new genus and *Vincentella*, therefore, stands.

The typical slender pedicels, reflexed narrow corolla-lobes and very short corolla-tube, the fairly large ovary, erect long anthers and long staminodes make it possible to recognise a species of *Vincentella* almost at once. Baehni retains *Vincentella* as a section *Bakerisideroxylon* of his large genus *Pouteria* Aubl. sensu Baehni, but it is so distinct that, in my opinion, it deserves generic rank.

V. sapinii (*De Wild.*) *Brenan* in Mem. New York. Bot 8: 498 (1954).

Bakerisideroxylon sapinii (" *Sapini* ") De Wild. in Rev. Zool. Afr. 7, suppl. bot. B 16 (1919), and in Pl. Bequart. 4: 116 (1926), type: *Sapin* s.n. BR, holo.; K, iso.

Pouteria tridentata Baehni in Candollea 9: 386 (1942); type: *Stolz* 1889 from Tanganyika in G, holo; K and PRE, isos.

Bakerisideroxylon stolzii Mildbr. Ms.

Vincentella stolzii (Mildbr. Ms. ex) Hutch., Botan. South Afr. 506 (1948), nomen nudum.

General Distribution.—Southern Tanganyika. Nyasaland and the Niassa Province of Portuguese East Africa, Northern Rhodesia and Belgian Congo, seems to prefer streambanks (teste Gomes e Sousa, Benson, Brass).

Nyasaland.—Kota-Kota distr.: *Benson* 257, 765 (PRE); Chia area, *Brass* 17510 (PRE).

Portuguese E. Africa.—Niassa: Nampula distr., Ribáué, *Gomes e Sousa* 2305 (PRE).

Tanganyika Territory.—Kyimbila: *Stolz* 1889 (isotype of *Pouteria tridentata* Baehni, PRE).

" A shrub or small tree, 4–6 m. high". (Gomes e Sousa). *Young* branches terete, densely rusty-tomentose-hirsutulous, later becoming shortly and more greyish-tomentose, the older ones ultimately glabrescent. *Leaves* oblanceolate-oblong to obovate-oblong,

with obtuse, rounded or emarginate apex and attenuated-cuneate base, with reflexed margin, 4–10 cm. long, 3–5 cm. wide (according to Baehni: 10–14 cm. long and 3–5 cm. wide), chartaceous or subcoriaceous, soon glabrous, rather shiny above, paler and duller beneath; midrib impressed and keeled above, very prominent and when dry longitudinally sulcate below, glabrescent but retaining the original tomentum somewhat longer than the rest of the blade; secondary nerves impressed above, prominent below, 8–12 on either side, rather distant (4–10 mm. apart), at first rather straight, ascending at an angle of 45°–70°, arcuate-ascending near the margin and reaching it except those near the apex; tertiary nerves inconspicuous above, subimpressed and rather distinct below, slender, mainly perpendicular to the secondary ones; ultimate nervation very fine reticulate, tessellate, rather distinct at least below. *Petioles* stout, densely rusty-tomentose-hirsutulous, 3–10 mm. long, flattened and canaliculate above. *Stipules* linear-subulate 4–5 mm. long, deciduous. *Flowers* fragrant (teste Benson). *Pedicels* 5–7·5 mm. long, hirsute, terete, slightly widening under the calyx. *Sepals* ovate-triangular, hairy outside glabrous inside, about $1\frac{1}{2}$ mm. long. *Corolla* white (teste Gomes e Sousa and Benson) glabrous, lobes narrowly-oblong, obtuse, $\pm$ 3 mm. long $\pm$ 1 mm. wide. *Staminodes* linear, acute, about as long as the corolla-lobes, with or a few small or minute lateral teeth. *Filaments* slender, 2·5–3 mm. long, the anthers $\pm$ 0·5 mm. long. *Ovary* ovoid-conical, hirsute, $\pm$ $1\frac{1}{2}$ mm. long and $\pm$ 1 mm. in diameter, attenuated into the long-subulate-linear, sulcate (at least when dry), subacute and glabrous $1\frac{1}{2}$–2 mm. long style. *Fruit* and *seed* not seen but fruit reported by Brass to be yellow, soft and edible.

5. LECOMTEDOXA

(*Engl.*) *Dubard* in Ann. Mus. Col. Marseille 23: 31 (1915); Baehni in Candollea 7: 456 (1938); Lam in Blumea 4: 348, 350 (1941).

Mimusops subgenus *Lecomtedoxa* (Pierre ex) Engl., Mon. Sapot. Afr. 82, t. 24, Fig. A. (1904).

Mimusops subgenus *Quaternaria* sectio *Inhambanella* Engl., op. cit., 80; Pilger in Engler & Prantl, Natürl. Pflanzenfam., ed. 1, Nachträge 1897–1904), exclus. descr. of the flowers.

Inhambanella (Engl.), Dub., tom., cit., 42, as to type species.

Type species.—*Mimusops kleiniana* Pierre ex Engl., Mon. Sapot. Afr. 82 (1904) = *Lecomtedoxa kleiniana* (Pierre ex Engl.) Dub. in Ann. Mus. Col. Marseille *23*: 31 (1915).

Small to very large trees. *Leaves* more or less distinctly crowded at the tips of the branchlets, coriaceous, more or less shiny above, paler and dull beneath. *Flowers* in few to many-flowered fascicles in the axils of the leaves or of leaf-scars below the leaves. *Calyx-lobes* 4–6; sometimes 3, sometimes unequal and subbiseriate, more or less erect, more or less concave. *Corolla* isomerous with the calyx; the tube short to rather long the lobes with each 2 lateral appendages (sometimes with only one appendage); the appendages entire, either very broad and larger than the lobes, or small. *Alternipetalous staminodes* lanceolate to ovate-lanceolate or long-triangular (resembling those of *Sideroxylon*), rather large and conspicuous, alternating with the corolla lobes. *Stamens* inserted in the throat of the corolla-tube or slightly higher up; filaments short or rather long; anters apiculate, included or slightly exserted. *Ovary* 5(-6)-loculate, hairy; ovules with lateral attachment; style glabrous, rather short, either capitate or tapering at the apex. *Fruit* 1-seeded, rather large. *Seed* with long scar occupying the ventral side of the seed; testa crustaceous; endosperm O or very thin; cotyledons thick and fleshy.

General Distribution.—2 or 3 species in tropical West Africa, one in Portuguese East Africa and Zululand.

L. henriquesii (*Engl. et Warb.*) ***A. Meeuse***, comb. nov.

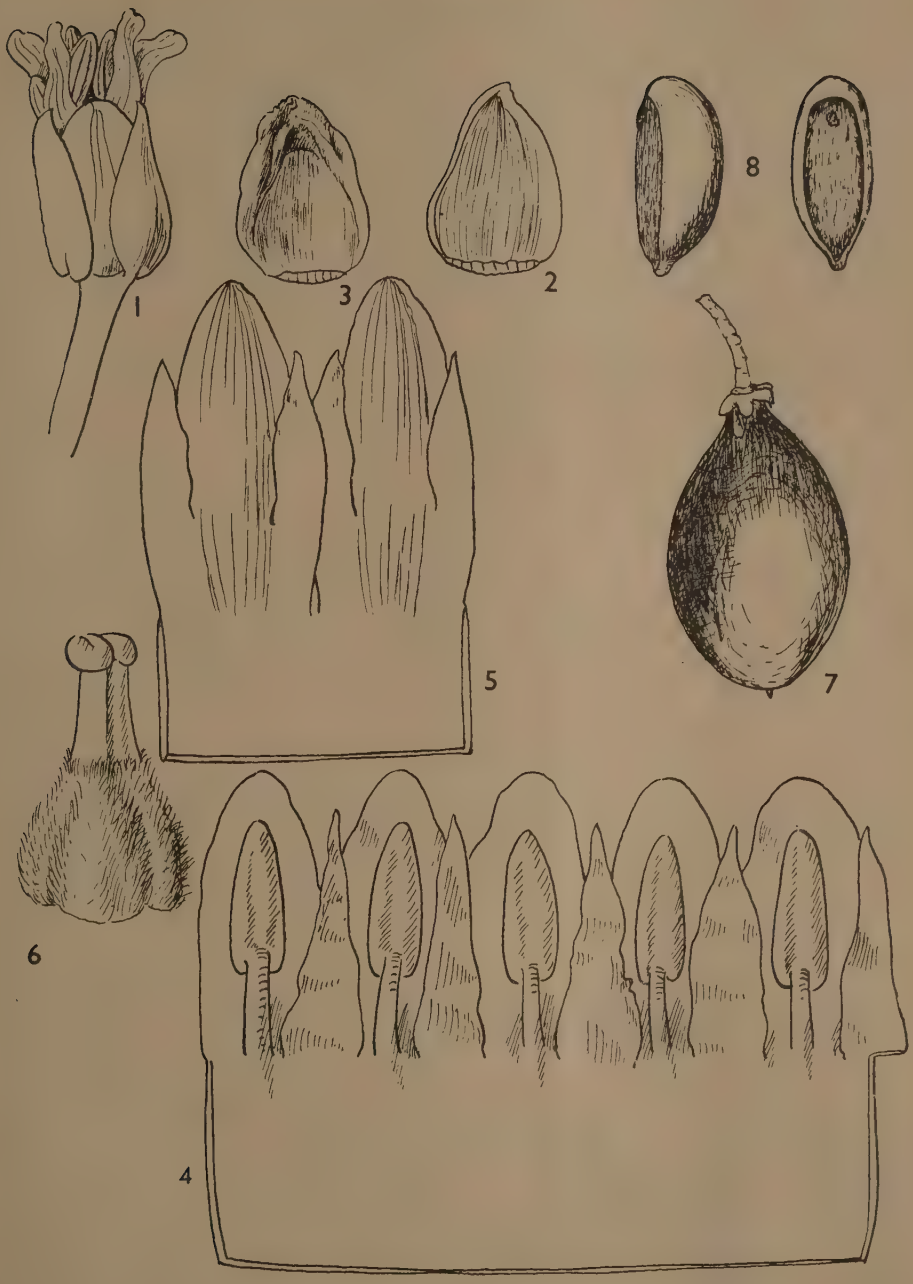
Mimusops henriquesii Engl. et Warb. in Engl., Mon. Sapot. Afr. 80 (1904), (sphalm. "*henriquezii*", cf. "Corrigenda", op. cit., p. 88); type: *Rolla Ferreira* s.n. from Portuguese East Africa in COI, holo! *M. henriquesiana* (Sphalm.?) Sim, For. Fl. Port. E. Afr. 80, t. 77, A (1909); Gerstner in J. S. Afr. Bot. *12*: 54 (1946).

Inhambanella henriquesii (Engl. et Warb.) Dub. in Ann. Mus. Col. Marseille *23*: 42 (1915).

As Engler's and Sim's descriptions are very incomplete and the flowers had hitherto not been known, a very detailed description is given.

Small to medium-sized tree, up to 20 m. high, with spreading branches and abundant heavy foliage. *Branches* rather stout, terete, longitudinally striate and sulcate, soon quite glabrous, greyish-born, later turning light grey and usually marked with scars. *Innovations* rusty-tomentose, but vegetative parts soon quite glabrous. *Stipules* subulate-falcate, pubescent, 3–7 mm. long, early deciduous. *Petioles* rather strongly canaliculate above and with a very narrow dorso-lateral wing or ridge on either side (which is a continuation of the edges of the decurrent leaf-base), when dry longitudinally sulcate, 12–35 (–52) mm. long. *Young growths* bright red to red-brown. *Leaves* varying from oblanceolate-oblong to oblong or obovate-oblong, obovate or broadly elliptic, coriaceous but rather thin, green (drying pale green or greyish green), 5–12 (–17) cm. long and 2¾–5 (–8) cm. wide, with obtuse, rounded or bluntly acuminate, often distinctly emarginate and more or less deflexed apex, acute or somewhat attenuate and slightly decurrent at the base, with reflexed margin, the edges often more or less undulate; almost invariable some leaves of each specimen with raised round flat or semiglobose galls; midrib impressed and keeled above, very prominent and when dry longitudinally sulcate below; secondary nerves 6–9 on either side, rather distant (5–10 mm., sometimes up to 25 mm. apart), not very conspicuous and often subimpressed (but sometimes slightly raised) above, usually prominent and more conspicuous below, slender, at first patent (ascending at angles between 45° and 90°), but mostly soon arcuate-ascending, the majority very strongly curved, becoming more or less sinuous and parallel with the edge of the leaf, ultimately reaching the nerve above it and thus forming a more or less distinct intra-marginal vein close to the margin, but some bifurcate or archingly joining; tertiary nerves more or less perpendicular to the midrib and joining the secondary ones, forming a coarse reticulation which is slightly prominent below; ultimate nervation very fine, reticulate, usually conspicuous at least on the lower surface. *Flowers* in few to many-flowered fascicles; bracts ovate, usually strongly concave to almost keeled and acute, 1–3 mm. long, pubescent; pedicels 5–20 mm. but usually 10–15 mm. long, terete or slightly angular, brownish-tomentose, rather abruptly widening into the calyx. *Sepals* 5 (or 4 to 6) erect, more or less concave, 4–5 mm. long, unequal to sub-biseriate; the outer 2–3 ovate-triangular from a broad base, 3–4 mm. wide, subacute, brownish-tomentose outside and inside near the margin and towards the apex; the inner ones thinner in texture, ovate-oblong, elliptic or broadly

FIG. 8.—*Lecomtedoxa henriquesii*, 1: Flower, x 5; 2: outer sepal; 3: inner sepal; 4: corolla tube, opened and seen from inside, x 10; 5: part of corolla tube seen from outside, showing the lateral appendages, x 10; 6: ovary, x 10, 7: fruit and 8: seed (7 and 8 from the type specimen, *Ferreira* s.n. in COI).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oblong, with a narrower base, obtuse or rounded at the apex, pale fawnish-tomentose-sericeous outside, glabrous inside, finely ciliate along the margin, usually only 2–3 mm. wide. *Corolla* glabrous, yellowish or white; the tube cylindric-campanulate, about 3 mm. long, the inside with distinct thickened lines below the stamens and the staminodes; the lobes elliptic or elliptic-oblong, 4–4·5 mm. long, and 2–3 mm. wide; lateral appendages shorter than or as long as the corolla-lobes, attached near the middle of the corolla-lobes or near the base, usually asymmetrical, ovate-lanceolate to lanceolate-falcate, 1–4 mm. long. *Alternipetalous staminodes* ovate-lanceolate or lanceolate to elongate-triangular, often somewhat undulate, entire, acute, or obtuse, glabrous, about 3 mm. long. *Stamens* inserted on the corolla-lobes slightly above the throat of the tube; filaments linear, 1–2·5 mm. long, glabrous, more or less winged and often with broad somewhat auriculate base; anthers oblong, minutely apiculate, 1·5–2·5 mm. long. *Ovary* ovoid-conical, about 1·5 mm. long and 1·5–2 mm. in diameter, more or less distinctly lobed, densely greyish-tomentose, usually 5-loculated; style glabrous, thick, columnar, terete or somewhat angular, about 1·5 mm. long and 0·5 mm. thick; stigma capitate, indistinctly 5-lobed and sometimes also bilobed. *Fruit* ellipsoid, about 4 cm. long and 2–2·5 cm. in diameter. *Seed* oblong, somewhat compressed, about 3 cm. long, 1·5 cm. wide and 1·2 cm. thick; testa crustaceous, shiny, scar oblong, about 28 mm. long and 6 mm. wide; cotyledons about 5 mm. thick.

Zululand.—Hlabisa: False Bay (according to Gerstner, l.c.; no specimen seen); St. Lucia Estuary, *Ward* 441 (NU); Mdlozi Peninsula, *Ward* 3032 (PRE).

Portuguese E. Africa.—Sul do Save: Maputoland, Santaca; *Gomes e Sousa* 3816 (COI, PRE). Manica e Sofala: Inhambane, *Rolla Ferreira* s.n. (COI, type); *Beira*, Vila Fontes, leg. *N.N.*, Labóratorio Quimico Herbario No. 77 (SRGH); Chissadze, Cheringoma, *Simão* 1559 (PRE); Dondo Junction, *Honey* 871 (BOL, PRE). Zambezia: Quelimane, between Mopeia and Morzumbala, *Barbosa & Carvalho 3960* (PRE). Locality not known to me (near Inhambane?): Maguiya da Costa, *Sim* 20911 (PRE).

The type is a specimen leg. *A. J. Rolla Ferreira* in 1903 (s.n.), " Regiões de Gaza e Inhambane ", but most probably from Inhambane, Portuguese East Africa, because Engler named it " *Inhambanella* " and Sim (l.c.) mentions " Ferreira's farm near Inhambane " as the place of origin. Engler erroneously mentioned: " Herb. Univ. Cordoba " instead of " Herb. Univ. Coimbra " as the location of the type specimen. Sim refers to this plant as " *Mimusops henriquesiana* " but as he mentions Ferreira's farm and the specific epithet is so similar, I am of the opinion that " *henriquesiana* " is a *lapsus calami* for " *henriquesii* ".

As regards the identity of *Mimusops henriquesii* and the other specimens cited above, the only fruiting specimen that I could study was the type, but the vegetative parts and the calyx agree in every respect with those of the flowering specimens cited here so that I feel certain that the identification is correct.

The species under discussion differs from the West African representatives of *Lecomtedoxa*, in that the lateral appendages are small and the fruit is only slightly attenuate near the base (in the W. African species the lateral appendages are larger than the corolla-lobes, and the fruits are markedly attenuate at the base). In all other essential characters, the South African species agrees very well with the West African ones, such as the structure of the calyx, the staminodes, the attachment of the ovules, the one-seeded fruit, and the seeds with long ventral scar and without (or with very scanty) endosperm. I see no reason to create a separate genus nor even a subgenus or section for the South African species, because the differences are only relative ones and, in my opinion, not at all important.

Lecomtedoxa is a remarkable genus in that it combines the possession of lateral appendages with (usually) 5-merous flowers, a monoseriate calyx (which, however, tends to be biseriate) and seeds with long scar (ovules with lateral attachment), and it forms a veritable link between the subfamily *Mimusopoidea* H. J. Lam (with biseriate calyces and 3-merous or 4-merous flowers) and the subfamily *Sideroxyloideae* H. J. Lam (with usually 4-merous flowers, and monoseriate calyx); especially the tribe *Pouterieae* H. J. Lam (which also has long seed-scars). The only other genera in which 5-merous flowers are found, combined with the presence of lateral appendages and monoseriate calyx, are the American genera *Bumelia* and *Dipholis*, of the *Sideroxyloideae-Bumelieae*. These two genera show great affinities to the genus *Sideroxylon* and certainly deserve their place in the *Sideroxyloideae*. *Lecomtedoxa* on the other hand, shows distinct affinities with the *Mimusopoideae* (subbiseriate calyx) and should, in my opinion be retained in this subfamily as was done by Dubard and by Lam.

In a note on *Ward* 3032 the collector mentions that the young growths (young leaves) are bright-red to red-brown which makes the trees quite conspicuous in spring.

6. AUSTROMIMUSOPS

A. Meeuse, gen. nov. *Inhambanella* Dubard, in Ann. Mus. Col. Marseille 23: 42 (1915), pro parte, non *Mimusops* Subgenus *Quaternaria* sectio *Inhambanella* Engl. in Mon. Sapot. Afr. 80 (1904). *Mimusops* Auct., pro parte.

Arbores vel frutices. *Folia* chartacea vel subcoriacea, conspicue ad apices ramulorum conferta; foliorum nervi secundarii et tertiarii atque venae tenuae, dense subtiliter reticulates. *Flores* 1–4 in axilis ad apices ramulorum (3–) 4 meri. *Sepala* (3 + 3 vel) 4 + 4, rarissime 5 + 5, elongata-triangularia vel lineari-oblonga vel linearilanceolata exterioribus et interioribus subaequilongis extus tomentosis, acutis vel interioribus obtusis, interioribus pallidioribus. *Corollae tubus* brevis; segmenta (6–) 8 appendiculis binis integris instructa. *Stamina fertilia* (6–) 8, staminus filamenta antheris breviora; antherae oblongo-lanceolatae vel lanceolatae connectivo apiculato. *Staminodia* elongata-triangularia vel lanceolata, integra vel interdum ad apicem plus minusve dentata, extus pilosa. *Ovarium* ovoideum vel subglobosum, hirsutum (6–) 8 loculare; ovula ad medium loculorum vel basi-laterale affixa; stylus exsertus, cylindratus vel subulatus vel filiformis, glabrus. *Bacca* ovoidea vel ellipsoidea, apiculata, monosperma raro 2-sperma. *Semen* ellipsoideum; area derasa (= cicatrix) magna, lata, semen longitudine subaequalis; testa crustacea vel plus minusve pergamacea; albumen nullum; cotyledones plano-convexae, crassae.

Type species: *Mimusops marginata* N. E. Br. (= *M. natalensis* Schinz non Engl.) = *Austromimusops marginata* (N.E. Br.) A. Meeuse.

Large shrubs or small to medium-sized trees with the leaves crowded at the very tips of the, often thick, branches. *Leaves* exstipulate, firm, but usually not coriaceous, not very shiny above, with a very fine tessellated reticular nervation which is always conspicuous at least on one side. *Petioles* distinctly, and usually widely, canaliculate above. *Flowers* in the axils of the leaves or of scaly bracts, 1–4 together, but as the leaves are crowded at the tips of the branches, apparently forming dense umbels of up to 20 flowers and over. *Pedicels* usually more or less pendulous. *Calyx* biseriate, the lobes free nearly to the base, (3 + 3 or) 4 + 4, very rarely 5 + 5, 3– and 4–, or 4– and 5– merous calyces occuring in one specimen; outer calyx lobes thicker and usually broader than the inner ones, which also differ in pubescence and are more or less distinctly midribbed. *Corolla* 3-merous and 4-merous (also occasionally 5-merous?) in one specimen, or 4- merous; the tube very short; the lobes and lateral appendages subequal. *Stamens* (6 or) 8, resembling those of *Mimusops*, i.e., the anthers longer

than the filaments, apiculate. *Staminodes* as in *Mimusops*, i.e., not deeply incised, lobed or fimbriate, usually quite entire, concave, hairy outside. Ovary 6– or 8– loculated, usually subglobose; ovules with lateral or sometimes basi-lateral attachment; style terete, subacute or subtruncate at the apex. *Fruit* one-seeded, rarely 2-seeded. *Seed* with rather thin, crustaceous or tough almost pergamaceous testa and a large broad scar occupying nearly the whole ventral side of the seed; endosperm absent; cotyledons thick and fleshy.

The genus contains at least four species, three found in Southern Africa, and one in tropical East Africa.

Engler, l.c., based his section *Inhambanella* of Mimusops on a specimen without flowers, mainly on the characters of the seed. Dubard, l.c., noticed that the ovules of the species *Mimusops natalensis* Schinz non Engl. (= *Mimusops marginata* N.E. Br.) are laterally attached and concluded that these ovules would give rise to seeds with a long lateral scar, so that this species could not be a true *Mimusops*. Although Dubard did not study the type specimen of *Mimusops henriquesii* (the type of Engler's section *Inhambanella*), he referred *Mimusops natalensis* Schinz to *Inhambanella*, which he raised to generic rank. This was a conjecture, because the flowers of *M. henriquesii* were unknown and Dubard had not seen the seed of *M. natalensis* Schinz.

However, *Mimusops henriquesii* is, in my opinion, a species of *Lecomtedoxa* (see p. 344) and therefore, the name *Inhambanella* either as a subgenus or as a genus being typified by *Mimusops henriquesii* Engl. et Warb., becomes a synonym of the genus *Lecomtedoxa* (Engl.) Dub. Dubard was, to my mind, quite right in excluding *M. natalensis* Schinz from *Mimusops*, but the name *Inhambanella* Dub. cannot be used for it and the congeneric forms, included here in *Austromimusops*. The affinities of *Austromimusops* are most probably with *Baillonella* Pierre which it resembles in floral characters, which are also very similar to those of *Mimusops*, but from which it differs in the absence of endosperm (*Baillonella* has a thin layer of endosperm), and the thin crustaceous to pergamaceus testa (thick and bony in *Baillonella*), and with the more or less dubious genera *Dumoria* Chev. and *Tieghemella* Pierre (= ?*Dumoria*).

Although the floral characters are very similar to those of *Mimusops*, there are so many differences that the generic distinction is not very difficult. The vegetative characters alone are almost sufficient to typify *Austromimusops*, apart from the characters of the seed. The following table (see Table II) shows the differences between the genera *Mimusops* s.s., *Austromimusops*, *Baillonella* and *Manilkara*. *Dumoria* and *Tieghemella* are not included, because it is very likely that they are identical with *Baillonella*, at any rate the characters of fruit and seed are apparently the same as those of *Baillonella*.

Leaves usually more than 6 cm. long, petiole usually over 10 mm. long. Pedicels 2–5 cm. long..... 1. *A. marginata.*

Leaves (at least the majority) under 6 cm. long, petiole 3–8 mm.; rarely up to 10 mm. long. Pedicels 0·9–2 cm. long:

Young parts, pedicels and calyces buffy-brown pubescent. Leaves $\frac{3}{4}$–2 (–2$\frac{1}{2}$) cm. wide, soon quite glabrous. Petioles soon glabrous. Pedicels 9–16 mm. long. Calyx-lobes 5–6 mm. long. Natal..... 2. *A. dispar.*

Young parts, pedicels and calyces rusty-pubescent. Leaves 1$\frac{1}{2}$–3$\frac{1}{2}$ (–4$\frac{1}{2}$) cm. wide, often showing vestiges of the rusty brown pubescence. Petiole often rusty-tomentose. Pedicels usually 1$\frac{1}{2}$–2 cm. long. Calyx-lobes ± 7 mm. long. E. Southern Rhodesia..... 3. *A. sylvestris.*

1. A. marginata (N.E. Br.) *A. Meeuse*, comb. nov.

Mimusops marginata N.E. Br. in Kew Bull. 108 (1895); Engl., Mon. Sapot. Afr. 71 (1904); Wright in Dyer, Fl. Cap. 4, 1: 441 (1906); Sim, For. Fl. Cape Col. 254, pl. 97, Fig. 1 (1907); Gerstner in J. S. Afr. Bot. 12: 54, Figs. 8, 9 (1946); type: *Flanagan* 27, K, lecto., BOL, GRA, NBG, PRE. isos! *M. natalensis* Schinz in Bull.

TABLE II.

	Mimusops.	Austromimusops.	Baillonella.	Manilkara.
1. Leaves.....	Scattered on the branches, coriaceous, smooth and shiny above, exstipulate.	Terminal on the branches firm but usually not coriaceous, not smooth and rather dull above, exstipulate.	Terminal on the branches, subcoriaceous, very large, smooth and shiny above, stipulate.	Almost invariably ± terminal on the branches, coriaceous or not, smooth and shiny above or dull ± and rough, exstipulate.
2. Nervation.....	Various but not distinctly parallel and rather lax without a very fine areolate tessellate nervation	Secondary nerves and tertiary nerves rather few, ultimate nervation very fine, tessellate, distinct.	Secondary nerves parallel, numerous; ultimate nervation areolate, distinct.	Secondary nerves usually numerous, parallel, fine reticulate nervation often present.
3. Calyx.....	Biseriate: always 4 + 4, the lobes rather long (± lanceolate)	Biseriate: 3 + 3, 4 + 4 or 5 + 5, the same specimen showing 3– and 4-merous calyces, the lobes as in *Mimusops*	Biseriate, 4 + 4, the lobes as in *Mimusops*	Biseriate, usually 3 + 3, sometimes 4 + 4, or 3 + 3 and 4 + 4 on one specimen the lobes relatively broad and rather short.
4. Corolla.....	8 lobes + 8 × 2 lateral appendages; appendages entire or dissected.	6 or 8 lobes with 12 or 16 appendages, respectively; 3-merous and 4-merous flowers on one specimen; appendages entire.	8 lobes with 8 × 2 appendages; appendages entire	Usually 6 lobes + 6 × 2 appendages; more rarely 8 + 8 × 2, appendages, sometimes 6 + 6 × 2 and 8 + 8 × 2 in one specimen; appendages entire; rarely appendages O.
5. Stamens.....	Stamens 8, Filaments shorter than the stamens, anthers (rather) long and narrow.	Stamens 6 or 8. Filaments and anthers as in *Mimusops*	Stamens 8. Anthers and filaments about as long, anthers rather wide and rather short.	Stamens 6, more rarely 8, sometimes 6 or 8 on one specimen. Filaments usually longer than anthers, the latter relatively short.
6. Staminodes.....	8, entire or serrate at the apex only, usually pubescent and incurved so as to cover the pistillum.	6 or 8 (on one specimen), as in *Mimusops*, entire or slightly fimbriate at the apex, hairy outside and incurved, covering the pistillum.	8, widened at about 1/3 from the base, hairy outside in the basal part, upper part spreading with the petals.	6, 8 or 6 and 8 sometimes less short or long, but almost invariably glabrous and laciniate, dentate, fimbriate or ± dissected, erect with the stamens or patent with the petals.
7. Carpels and ovules	Ovary 8- (rarely 16-) loculated; ovules basally affixed.	Ovaries can be 6-and 8-loculated in one specimen; ovules laterally affixed.	Ovary 8-loculated; ovules laterally attached.	Ovary 15-6-loculated (usually 6- loculated; in 4-merous flowers 8-loculated), ovule usually ventrally affixed, more rarely almost basal.
8. Fruit and seed (cicatrix and testa)	Fruit 1- to several-seeded; scar almost invariably small, circular and almost basal; testa hard, bony, shiny.	Fruit 1- seeded rarely 2-seeded; scar very large, ventral, occupying ± the whole length of the seed; testa leathery or crustaceous, not hard, dull	Fruit 1-seeded, large; scar very large, occupying the ventral half of the seed; testa thick, hard and bony, shiny.	Fruit 1- to several-seeded scar basiventral, relatively long and narrow, more rarely broader and ovate or ± circular and almost basal, testa usually hard, bony and shiny, sometimes crustaceous.
9. Embryo and endosperm	Endosperm copious; cotyledons thin, foliaceous.	Endosperm O; cotyledons thick and fleshy.	Endosperm thin; cotyledons thick and fleshy.	Endosperm copious; cotyledons thin, foliaceous.

Herb. Boiss. 4: 441 (1896); type: *Schlechter* 6220 in Z. " *M. transvaalensis* Schinz " (sphalm.), Radlk. in Zahlbr., Pl. Penther. I, in Ann. K.k. Naturh. Mus. Wien 15: 63 (1900). *M. schinzii* Engl. op. cit., 70, t. 29, Fig. A; Wright, op. cit., 443, Gerstner, l.c., 54 (same type as *M. natalensis Schinz*).

Inhambanella natalensis (Schinz) Dubard in Ann. Mus. Col. Marseille 23: 42 (1915).

A tree found in rather moist forests. *Stem* straight, 6–20 m. high and 30–60 cm. in diam. *Branches* terete, grey, more or less rough; ultimate branches short and rather stout, usually over 3 mm. thick, often much thicker, glabrous. *Innovations* densely rusty tomentose-villous, but all vegetative parts soon quite glabrous. *Leaves* obovate or elliptic-obovate, sometimes elliptic-oblong or elliptic-(ob)lanceolate, thinly coriaceous with a dull shine (but not smooth) and drying a greyish green (rarely brown) above, paler and duller below, 3–15 (usually 6–13) cm. by 2–9 cm., as a rule more or less acuminate with obtuse apex, a narrowed or somewhat rounded base and subreflexed margin; midrib distinct but not conspicuously keeled or channelled above, prominent below; lateral nerves slender but prominent beneath; ultimate nervation very fine, reticulate, usually conspicuous on at least one surface. *Petioles* (5–) 10–20 mm. long, rather stout, semi-terete, strongly and widely canaliculate. *Flowers* 1–3 in axils of leaves and of scales inside them, more or less pendulous on 2–5 cm. long pedicels, 3-merous or 4-merous. *Calyx* biseriate, outer lobes rusty-pubescent, inner ones pale-pubescent, all acuminate, acute, 7·5–12 mm. long. *Corolla* dull white; tube 1–2 mm. long, pubescent outside, lobes and appendages subequal, 6–9·5 mm. long. *Staminodes* 6–8, densely villous outside, 4·5–5·5 mm. long. *Stamens* 6–8 mm. long. *Ovary* 6– of 8– celled; style 9–11 mm. long. *Fruit* rather large, ovoid or ellipsoid, apiculate or attenuate-apiculate, pointed, ultimately glabrous, purplish red, up to 5 cm. long and 3½ cm. diameter, on the slightly incrassate, but not lengthened pedicel; fruiting calyx spreading-reflexed. *Seed* broadly ellipsoid, 20–25 mm. long, about 20 mm. wide and about 18 mm. thick; testa crustaceous, dull, pale buff when dry; scar somewhat shorter than the seed, occyping about half its surface area, elliptic or oblong in outline, emarginate at the apex and about 20 mm. broad in the widest place.

N. E. Brown did not designate a type specimen but Mr. de Winter informed me that the only specimen at Kew with fruits is *Flanagan* 27, so that most probably the fruits were described from this specimen. Accordingly, I propose *Flanagan* 27 (in K) as the lecto-type. Type locality: Komgha, E. Cape.

Distribution.—From East London northwards into Natal, Zululand and Portuguese East Africa, just crossing the Transvaal border.

Cape Province.—East London: *Sim* 2182, 2183, 2190 (= ?2194 collect. No.) (NU), 2194 (BOL), 2602, s.n. (PRE); *Acocks* 10979, 12298 (PRE), *Courtney Latimer* s.n. (PRE), *Rattray* 1371 (BOL). Komgha: Gwenkala, *Flanagan* 27 (PRE, GRA, BOL, SAM, isotypes); *Schlechter* 6220 (GRA, isotype of *Mimusops natalensis* Schinz = *M. schinzii* Engl.). Kentani: *Pegler* 692 (PRE, BOL, NBG).

Natal.—Port Shepstone: near Mehlomnyama, *Marais* 7871 (PRE). Umzinto: Dumisa, *Rudatis* 450 (L). Pinetown: Dellville, *Smuts* s.n. (NH No. 17830); Warner Beach, *Ward* 977 (NU, PRE); Amanzimtoti, *Williams* 65 (NU); Marianhill, *Forbes* 1041 (NH); Umlaas, *Wood* 5440 (NH); *Kotze* 436 (PRE) = FD Herb. No. 6858 (SAFD). Durban: Inanda, *Wood* 1661 (NH). Camperdown: Hammarsdale, *Forbes* 310 (NH). Empangeni: Utimona, *Gerstner* 2748 (BOL, NH, PRE). Nongoma: Wendelane Kloof, *Gerstner* 4657 (NH, PRE, BOL, NBG). Hlabisa: *Gerstner* 3817 (NH); Hluhluwe Game Reserve, *Ward* 1599. Ngotshe: Ngome Bush, *Gerstner* 2591 (NH, BOL). Ingwavuma: Cecil Mack's Pass, about 8 m. N. of Ingwavuma, *Acocks* 13129 (PRE); *Codd* 2074 (PRE). Without precise locality: " Zululand ", *Gerstner* 2820 (BOL).

Transvaal.—Nelspruit: Kruger National Park, Crocodile River Poort, *van der Schijff* 3960 (PRE).

2. A. dispar (*N.E. Br.*) *A. Meeuse*, comb. nov.

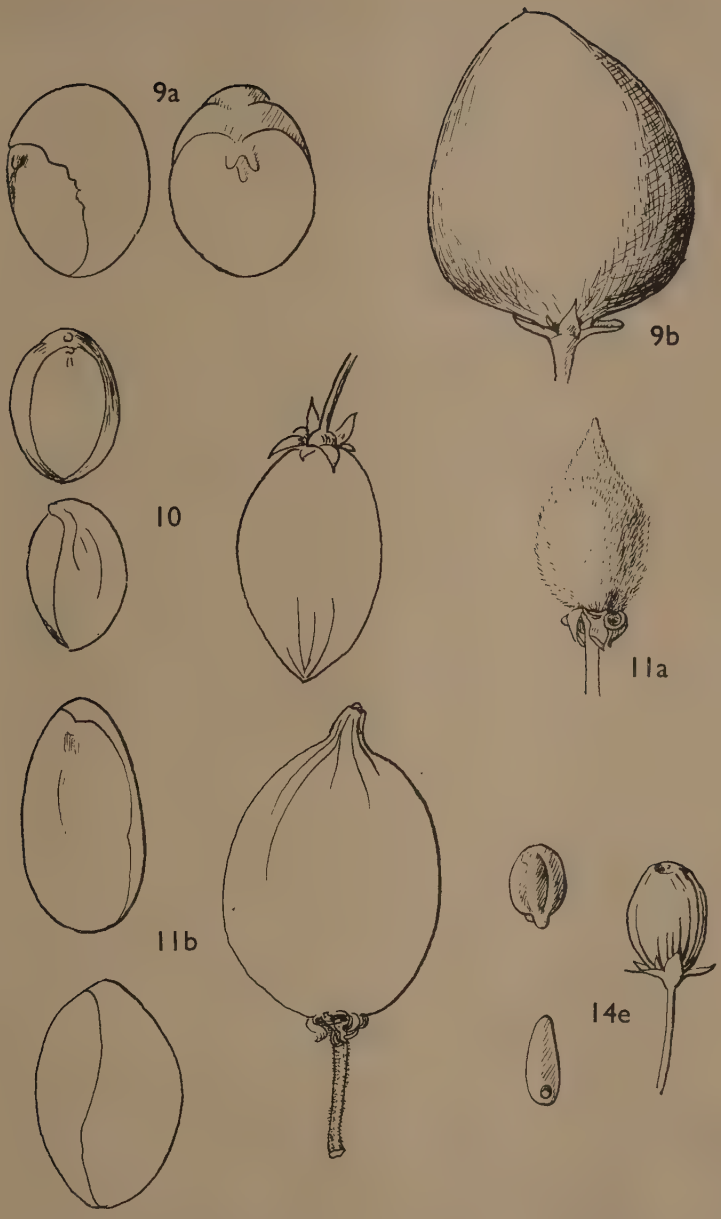
Mimusops dispar N.E. Br. in Kew Bull. 1895: 107; Engl., Mon. Sapot. Afr. 71 (1904); Wright in Dyer, Fl. Cap. 4, 1: 443 (1906); type: *Thresh* in herb. Wood No. 5425 from Natal, K, lecto., GRA, NH, isos.!

A large shrub or small tree, up to about 10 m. high. *Branches* light grey, terete, usually rather rough and the younger ones marked in stretches with the scars of fallen leaves of a previous generation, but these stretches are not so sharply defined as in *A. sylvestris* (see No. 3); ultimate branches short to very short (unbranched twigs usually less than 10 cm. and often less than 5 cm. long). *Innovations* fulvo-sericeous, but leaves, petioles and twigs soon glabrescent. *Leaves* oblanceolate-cuneate, or oblanceolate-obovate to obovate-oblong, firm but not coriaceous, rather dull and drying green or yellowish-green above, paler and duller beneath, 2–6 (–7) cm. long and 0·75–2 (–2·5) cm. wide, on a 3–8 (–10) mm. long, subterete, widely canaliculate petiole; blade with a very slightly reflexed margin, obtuse, subacute or shortly and bluntly acuminate, but not usually rounded at the top, gradually narrowing into the acute or acuminate-decurrent base; midrib hardly prominent above, rather prominent below; secondary nerves 6–9 on either side, not very distinct from the tertiary ones, ascending at an angle of 45°–60°, rather straight, bifurcate or branched well within the margin and more or less irregularly archingly joining; tertiary nerves mainly parallel to the secondary ones, but branching and anastomosing to form a rather coarse reticulum which is filled up by a very fine areolate nervation, the latter conspicuous on both sides of the leaf. *Flowers* few to many (over 20) on one twig, bracts minute; pedicels rather slender, more or less angular, especially in the slightly thickened part under the calyx, 9–16 mm. long, buffy-brown tomentose. *Sepals* 3 + 3 or 4 + 4; the outer ones ovate-triangular, acute, or subacute, buffy-brown-tomentose outside, with a whitish margin, greyish-tomentose inside near the tip, 5–6 mm. long and about 3 mm. wide; the inner ones about as long and as wide as the outer ones, thinner in texture, ovate-oblong, more obtuse, greyish-pubescent outside with a slightly darker longitudinal streak in the middle and inside at least in the upper half. *Corolla* yellowish, glabrous; the tube very short, about 0·5 mm. long; the lobes and lateral appendages subequal, linear-lanceolate, acute, or subobtuse, 5–6 mm. long and 1–1·5 mm. wide. *Stamens* 6 or 8; filaments 1·5–2 mm. long, subulate from a broad flattened base, the apical part capillary; anthers ovate-lanceolate, acute, 2–3 mm. long, minutely apiculate. *Staminodes* ovate-lanceolate, long-acuminate, concave, hairy at the back, about 3 mm. long. *Ovary* subglobose, densely villous, about 2 mm. in diameter; style glabrous, rather short and comparatively thick, terete, subulate-columnar, 2–3 mm. long, the apex subacute.

Fig. 9.—*Austromimusops marginata*, seed and fruit (from *Pegler* 692, Kentani, E. Cape, in BOL).

Fig. 10.—*Austromimusops dispar*, seed and fruit (from *Pentz et al.* "1 A", Weenen Veld Reserve, Natal).

Fig. 11.—*Austromimusops sylvestris:* (*a*) immature fruit (to show the dense pubescence; from *Chase* 4328, Umtali, S. Rh.) (*b*) mature seed and fruit (from seeds sent by Mr. N. C. Chase, coll. in Waranki Reserve, Umtali, S.R.)
N.B.—The seed figured was from a large 2-seeded fruit; as a rule the seeds are shorter and comparatively thicker.


9a
9b
10
11a
11b
14e

Fruit green or yellowish-green, ellipsoid or ovoid, apiculate, more or less densely covered with a short brown pubescence, 2–3 cm. long, 1·5–2 (–2·5) cm. in diam.; pericarp thin, almost leathery when fresh, 1- or rarely 2-seeded. *Seed* pale brown, 2–2·5 cm. long and 1·5–2 cm. in diam. with pale whitish scar.

NATAL.—" Thorns " nr. Greytown, *Thresh* in herb. Wood 5425 = NH No. 7175 (NH, GRA, isos!). Estcourt: Mooi Rivier, " Thorns ", *Wood* 4472 (NH); *Sim* 2187, 2188 (NU). " Upper Tugela River:" *Gerrard* (and *McKen*) 1482 (NH). Weenen: Weenen Veld Reserve, *Acocks* 10148 (PRE, NH), *Pentz & Acocks* = *Acocks* 10721 (PRE, NH), *Pentz* 116, 596; " 1 " (Coll. in 1952), " 2 " (coll. in 1952). " 1A " and " 1B " (coll. in 1953 from same trees as " 1 " and " 2 " respectively); all in PRE, the last three fruiting specimens); *West* 1189, 1190 (PRE); Muden, *Sim* 19078, 19138 (PRE), *Verdoorn* 1727 (PRE). Msinga: Confluence of Mooi and Tugela Rivers, Ngobevu, *Edwards* 881 (NU. PRE). Umvoti: Keats Drift, *Edwards* 916 (NU, PRE).

3. A. sylvestris (*S. Moore*) *A. Meeuse*, comb. nov.

Mimusops sylvestris S. Moore in J. Linn. Soc. (Bot.) 40: 132 (1911); type: *Swynnerton* 570 from Southern Rhodesia in BM, holo.

A shrub or small tree, up to about 7 m. high, with smooth bole. *Branches* terete, greyish, with longitudinal shallow grooves and with slightly thicker stretches marked with rough transverse leaf-scars, especially towards the tips of the twigs below the leaves; ultimate branches rather short (5–15 cm. long) and rather stout (more than 2 mm. thick, sometimes much thicker and up to 6 mm. in diam.), usually with a thicker scarred area just below the leaves. *Buds*, *young leaves* and *young twigs*, *pedicels* and *bracts* densely rusty-tomentose. *Leaves* obovate or obovate-oblong, sometimes oblong or oblong-cuneate, 2·5–6 (–7·5) cm. long and 1·5–3·5 (–4·5) cm. wide, on a rather stout, terete, rather widely canaliculate, rusty-pubescent but ultimately glabrescent, 2–6 mm. long petiole; blade with revolute margin, an obtuse, rounded, emarginate, or more or less retuse, rarely very shortly and bluntly acuminate apex and a narrowed, usually acute but sometimes rounded base, rather firm but not coriaceous in texture, ultimately glabrous and green but not smooth or shiny above, glabrescent but not soon quite glabrous, paler and duller below, midrib usually keeled, sometimes immersed above, rather prominent beneath and keeping vestiges of the original rusty pubescence for a long time; secondary nerves (5–) 7–10 (–12) on either side, as a rule very distinct below, immersed above, rather straight, making an angle of about 60° with the midrib, usually bifurcate well within the margin and more or irregularly joining, but mostly with one distinct ascending branch; tertiary nerves mainly parallel to the secondary ones, but usually sinuous, branched or more or less reticulate; ultimate reticulate nervation very fine, areolate, in dried leaves usually conspicuous on both sides. *Flowers* 1–3 together; bracts densely rusty-tomentose, ovate, 2 mm. long, deciduous; pedicels usually 1·5–2 cm. long, rather stout, terete, but gradually widening near the apex into the calyx, usually pendulous; in fruit not lengthened but slightly incrassate. *Sepals* 4 + 4 or 5 + 5; the outer ones ovate-lanceolate to oblong-lanceolate, about 7 mm. long and 3–3·5 mm. wide, acuminate or narrowed towards the subobtuse apex, densely rusty-tomentose with a distinct greyish-tomentose margin outside, greyish-tomentose inside at least in the upper half; the inner ones somewhat shorter and narrower, greyish pubescent outside with a darker longitudinal streak and inside at least in the upper half. *Corolla* glabrous; the tube about 1 mm. long; the lobes about 7 mm. long, oblong-lanceolate; the appendages slightly shorter. *Filaments* more or less flattened, rather slender, 1·5 mm. long; anthers oblong, obtuse, apiculate, 3 mm. long. *Staminodes* long-triangular-lanceolate, concave, with acuminate, dissected, 2–3 fid or somewhat fimbriate apex, villous with long sinuous hairs outside, the upper half strongly inflexed. *Ovary* sub-globose, about 2 mm. in diam, densely villous; style glabrous, 6–7 mm. long, terete, tapering towards the apex, somewhat truncate-capitate at the tip. *Fruit*

ovoid-ellipsoid, attenuate-apiculate, 3–4·5 cm. long and 2–3 cm. in diam., when young densely rusty-tomentose, glabrescent and dull brown when mature, 1-seeded or 2-seeded; pericarp not juicy, rather dry and leathery. *Seed* broadly ellipsoid to subglobose (those of 2-seeded fruits ellipsoid, more slender), 20–32 mm. long, ± 20 mm. in diam.; testa dull, very pale straw-coloured; the scar duller and somewhat lighter in colour (see Fig. 13).

S. Rhodesia.—Umtali: Dora Farm, *Chase* 964, 965, 966, 774 (SRGH, *Chase* 965 also in PRE); Glenshiel Farm, *Chase* 1670 (SRGH); Zimunya Reserve, *Chase* 4238 (SRGH, PRE); Maranki Reserve: *Chase* s.n. (ripe fruits, PRE). Bikita: *Wild* 4393 (PRE, SRGH).

Mr. B. de Winter compared the type, *Swynnerton* 570, with *Chase* 966 (Kew) and informed me that there are some minor differences such as shorter and more hairy petioles, smaller flowers, wrinkled leaves. However, the material I have seen is rather variable and the differences mentioned by Mr. de Winter are well within the range of variation, so that I have no doubt about the specific identity.

Apart from the three species dealt with, there is at least one species in tropical Africa. This species, described as *Mimusops cuneata* Engl., has several characteristics of an *Austromimusops* : leaves congested at the ends of the branchlets, with their largest width above the middle, axillary flowers on pendulous pedicels and laterally attached ovules. Judging by Engler's figure and a specimen named *Mimusops cuneata* (*Drummond & Hemsley* 4203 from Kenya, Kwale Distr., EA, K, PRE) this is very close to *Austromimusops dispar* (but it is much more glabrous than the latter) and to *A. marginata*, and although the fruits are apparently still unknown, I do not hesitate to refer it to the same genus:

Austromimusops cuneata (*Engl.*) *A. Meeuse*, comb. nov.

Mimusops cuneata Engl., Pflanzenw. O. Afr., C, 307 (1895), and Mon. Sapot. Afr. 70, t. 23, C (1904); Brenan and Greenway, Checklist Tang. Terr. 2: 565 (1949). Recorded from Tanganyika (West-Usambara) by Engler; also in Kenya.

7. MIMUSOPS

L., Gen. Pl. ed. 5: 175 (1754), p.p.; Harvey, Gen. S. Afr. Pl. 224 (1838), A. DC. in DC., Prodr. 8: 202 (1844), p.p.; Bentham et Hook., Gen. Pl. 2: 661 (1876), p.p.; Baker in Oliv., Fl. Trop. Afr. 3: 505 (1877), p.p.; Hartog in J. Bot. 17: 358 (1879), p.p.; Engler in Engl. & Prantl., Naturl. Pflanzenfam., ed. 1, 2, 4: 150 (1899), and in Nachträge (1897) 278, pro parte; Engl., Mon Sapot. Afr. 50 (1904), p.p.; Pilger in Engl. & Prantl, Nachträge 1897–1904, 288 (1906) p.p.; Wright in Dyer, Fl. Cap. 4, 1: 439 (1906), p.p.; Dubard in Ann. Mus. Col. Marseille 23: 46 (1915), Baehni in Candollea 7: 465 (1938); Lam in Blumea 4: 345–347 (1941); Phillips, Gen. S. Afr. Fl. Pl. ed. 2, 568 (1951), p.p.; Royen in Blumea 6: 594 (1952).

Type species: *Mimusops elengi* L., Sp. Pl. ed. 1: 349 (1953). Linnaeus mentioned two species, *M. elengi* and *M. kauki*. *Mimusops kauki* L. is now generally assumed to be the type species of *Manilkara* Adans. [see discussion by Van Royen in Blumea 7: 406 (1953)], which makes *M. elengi* L. undoubtedly the type species of *Mimusops* L. apart from priority of place.

Trees or shrubs. *Leaves* extipulate, not conspicuously crowded towards the tips of the branches and without sclereids and with a rather lax, not conspicuously parallel or " striate " secondary nervation. *Flowers* axillary, pedicellate, constantly 4-merous., *Calyx* biseriate (4 + 4); the sepals free nearly to the base, often long and narrow.

Corolla 8-lobed, each lobe with 2 dorsal appendages; the latter entire or divided (in S. Africa always entire). *Stamens* 8, inserted in the throat of the corolla tube; the anthers usually (in S. Africa always) shorter than the long, more or less lanceolats and apiculate anthers. *Alternipetalous staminodes* 8, entire, or somewhat dentate, lacerate or fimbriate at the apex only, often pubescent at least at the back or along the edges (in S. Africa never glabrous), incurved, and more or less covering the style. *Ovary* 8-loculated; ovules with basal attachment; style rather long and slender, cylindric-subulate to filiform. *Fruit* a 1- to few-seeded berry. *Seeds* with a small, circular and almost basal scar; testa shiny hard and thick; endosperm copious, cotyledons thin, foliaceous.

The genus *Mimusops* as understood by Bentham and Hooker, Hartog, Engler and several others is most heterogeneous and comprises forms with 3-merous and others with 4-merous flowers, species with long and narrow ventral seed-scar and others with circular basal scar, plants with staminodes and others without staminodes, forms with endosperm and others without endosperm, etc. Dubard (1915) excluded many species and referred them to several other genera, the majority to *Manilkara* Adans. The latter genus is now almost universally adopted, cf. Van Royen in Blumea 7: 401 (1953), but is should be borne in mind that the large genus *Mimusops sensu* Hartog and Engler does not become more homogeneous if only *Manilkara* is taken out. If, however, *Muriea*, *Austromimusops*, *Baillonella*, *Lecomtedoxa* and perhaps several other smaller genera are also exluded, the remainder of *Mimusops* is a reasonably well defined homogeneous genus. In its limited sense, *Mimusops* L. sensu Dubard, Lam and Van Royen comprises between 30 and 40 species, all occuring in Africa, Madagascar, and the Mascarenes, with the exception of *M. elengi* L., a coastal form which occurs in tropical Asia and the W. Pacific. Three species in Southern Africa:

Leaves obovate, obovate-cuneate or almost obcordate, always distinctly narrowing towards the base, usually emarginate or retuse, with strongly revolute edges and at least when young, with white sometimes fulvous adpressed, more or less silky pubescence below (very old leaves glabrous). Coastal tree..... 1. *M. caffra*.

Leaves different, glabrous when old or with " powdery " vestiges of a rusty brown pubescence:

Petioles under 1 cm. long; leaves usually rather small (mostly under 6 cm. long) and usually drying dark brown; branches and leaves very soon glabrous; flowers about 2 cm. in diameter when fully expanded, very rarely smaller, usually solitary in the axles, sometimes 2 together, usually not numerous on a single branchlet..... 2. *M. obovata*.

Petioles over 1 cm. long; leaves often over 6 cm. long, innovations and young leaves, as well as tips of young branches densely rusty-pubescent, the tips of the branches often remaining pubescent for a considerable time, flowers up to 1·5 cm. in diam, when fully expanded, often in clusters of more than 2 flowers, often numerous on a single branchlet..... 3. *M. zeyheri*.

1. **M. caffra** *E. Mey.* ex *A. DC.*, Prodr. 8: 203 (March 1844); Wood, Natal Pl. 1: 36, t. 43 (1898); Engl., Mon. Sapot. Afr. 72, t. 27, Fig. B (1904); Wright in Dyer, Fl. Cap. 4, 1: 441 (1906), Sim, For. Fl. Cape Col. 255, fol. 97 (1907); and For. Fl. Port. E. Afr. 80, pl. 75 (1909); Gerstner in J. S. Afr. Bot. 12: 52, Fig. 7 (1946). *M. caffra* E. Mey. ex Drege, Zwei Pflanzeng. Doc. 155 (1843), nomen tantum; type: *Drege* s.n. from Pondoland in G ex herb. DC, holo, L, iso! *M. revoluta* Hochst. apud Krauss in Flora 27: 825 (Dec. 1844); type: *Krauss* 76 from Durban in ?, holo, K iso .

A small tree or large shrub, forming a large propertion of the vegetation on the sand dunes, growing down to the high-water mark and fully exposed to sea winds and spray; exposed specimens usually dwarfed and gnarled, but in sheltered places growing up to about 10 m. high and over 50 cm. stem diameter. *Branches* terete, usually rather stout (about 3 mm. thick), densely leafy towards the tips. *Innovations* densely rusty-tomentose. *Leaves* obovate, obovate-oblong or obovate-cuneate to almost obcordate,

3–6 (–7) cm. long and 1·5–3 (–4) cm. wide; blade firmly coriaceous usually with strongly reflexed margin, glaucous and glabrous above, paler and adpressed silky-pubescent beneath (almost invariably white or silvery), with usually rounded emarginate to retuse apex, tapering into the 5–10 (–15) mm. long petiole; midrib usually a little prominent above in the lower half of the leaf, or flush, rarely somewhat immersed, prominent beneath at least in the lower half; secondary nerves almost straight, slightly prominent on both sides, forming an angle of 30°–50° with the midrib, joining a conspicuous, sinuous intramarginal vein; tertiary nerves and finer nervation hardly more slender than the secondary nerves, and mainly parallel to the latter. *Petioles* terete, slightly thickened towards the base, narrowly but rather deeply channelled above, ultimately glabrous, 5–10 (–15) mm. long. *Flowers* usually numerous on one branchlet, often 2–4 together in the leaf axils. *Pedicels* usually recurved, 2–3 cm. long, mostly distinctly 4-angled, shortly rusty-tomentose (this pubescence tending to become grey later), more or less gradually widening into the calyx. *Flower-buds* about 12 mm. long just before opening. *Sepals* lanceolate, acuminate, about 1 cm. long; the outer ones rusty-tomentose outside, about 3 mm. wide, the inner ones with pale tomentum, about 2 mm. wide. *Corolla* about as long as the calyx, glabrous; the tube short, the lobes about 10 mm. long, each with two about 7 mm. long appendages, all segments lanceolate, usually in two rows consisting of an outer row of 16 appendages and an inner row of 8 corolla lobes. *Filaments* about 2·5 mm. long; anthers about 6 mm. with acute apiculum. *Staminodes* triangular-ovate, slightly longer than the filaments, densely pilose outside with long hairs. *Ovary* ovoid, densely pilose, about 2 mm. long; style long-cylindrical, tapering into an acute point, about 11 mm. long. *Fruit* ovoid, 1·5–2 cm. long, 1–1·5 cm. diam., more or less rounded at the top but often contracted into and crowned by the persistent style, red when ripe, edible, usually (always?) 1-seeded; fruiting pedicels hardly lengthened, slightly incrassate, up to 3 cm. long and about 2 mm. thick; calyx-lobes persistent under fruit, adpressed to the fruit, greyish pubescent. *Seed* oval, subcompressed, indistinctly keeled at the ventral side, not produced at the base, 13–17 mm. long, 8–9 mm. wide and 5–7 mm. thick in the middle; testa shining brown.

Selected Citations.

Cape Province.—Bathurst: Kowie and Port Alfred, *Burchell* 3805; *Britten* 2107, *Marloth* 18097; *Burt-Davy* 7856; *Tyson* s.n.; *Story* 2163. East London: *Galpin* 1835, 9285; *Smith* 3817. Komgha: Kei Mouth, *West* 2024. Kentani: *Pegler* 1298. Elliotdale: *O. B. Miller* FD herb. No. 5591 (SAFD). Port St. Johns: *Schönland* 4038, *Mogg* 770 (= photo of tree, PRE); *Howlet* 44.

Cape Province or Natal.—Bizana or Port Shepstone: "between Umtentu and Umsamkulu", *Drege* (L, isotype).

Natal.—Port Shepstone: Margate, *Bayer* 1305 (NU); Port Shepstone, *Mogg* 13197. Umzinto: "South Coast, nr. Botha House", *Smuts* 2325; Sezela, *Smuts* s.n. Pine Town: Winkle Spruit, *Rudatis* 1608; Amanzimtoti, *Kotzé* 453. Durban: near Durban, *Forbes & Obermeyer* 72. Lower Tugela: Stanger, *Pentz* 386. Mtunzini: Inyoni bush, *Gerstner* 1936. Hlabisa: St. Lucia Bay, *Lansdell* 31 (NH). Ubombo: near Sordwana Bay, *Gerstner* 733; *Ward* 3013.

Portuguese E. Africa.—Sul do Save: Lourenço Marques, *Schlechter* 11986; *Rogers* 21374; *Junod* 134; *Borle* 30; *Pedro* 59; *Gomes e Sousa* 3770; Maputo, *Hornby* 2619; Inhaka Island, *Mogg* s.n.; Chongoene, *Pedro & Pedrogão* 1645. Manica e Sofala: Inhambane, *Earthy* 172 (PRE); *Gomes e Sousa* 1701, 1739, 1908 (COI).

As regards the synonymy, *Mimusops caffra* was the only name used for this species in all recent publications, but Krauss in 1844 validly published *Mimusops revoluta* Hochst., based on *Krauss* 76 from Durban. Strangely enough, this name was not

mentioned by Engler (op. cit.) as a synonymn of *M. caffra* and is not cited in Fl. Cap., although the number *Krauss* 76 is quoted in the latter publication. Mr. de Winter kindly supplied the information that an isotype is present in the Kew herbarium and that it is identical with *M. caffra*. Fortunately, the publication of *M. caffra* E. Mey ex A. DC. antedates that of *M. revoluta* Hochst. apud Krauss by several months (mid March 1844 against December 1844) so that the well-known and generally used name *M. caffra* need not be changed.

M. caffra is found on coastal sand dunes from Port Alfred (Bathurst) eastwards and northwards to Portuguese E. Africa, also here and there along large rivers more inland on sandy soil.

2. **Mimusops obovata** *Sond.* in Linnaea 23: 17 (1850); Harvey, Thes. Cap. 1: 28, t. 44 (1859); Engler, Mon. Sapot. Afr. 72, t. 27, Fig. D (1904); Sim, For. Fl. Cape Col. 254, pl. 96 (1907); Wright in Dyer, Fl. Cap. 4, 1: 442 (1906); Marloth, Fl. S. Afr. 3: 36, t. 10 (1932); Gerstner in J. S. Afr. Bot. 12: 54, Fig. 10 (1946); type: *Ecklon & Zeyher* "Sideroxylon No. 16" from Alexandria, lecto! in S, isos! in GRA, PRE.

Imbricaria obovata N. ab. E. ms. ex Sonder, l.c. in syn., Engler, op. cit., 72, in syn.

Mimusops oleifolia N.E. Br. in Kew Bull. 1895: 109 Engler, op. cit., 73, t. 34, Fig. B; Wright, op. cit., 442; type: *Gerrard* 1642 in K, holo., NH, iso! from "Tugela", Natal.

M. woodii Engl., op. cit., p. 65, t. 26, Fig. A; Wright, op. p. 440; type: *Wood* 683 in B, holo†, BOL, NBG, isos! from Inanda, near Durban.

M. rudatisii Engl. et Krause in Engl. Bot. Jb. 49 (1913), p. 395; type: *Rudatis* 1136 in B, holo†, L, PRE, isos! from Dumisa, Natal.

A medium-sized tree, up to 20 m. high and 60 cm. stem diam., according to Sim (in MS.) occuring mainly in rather open mountain forests, but also in coastal areas. *Branchlets* terete, glabrous, rather slender, usually longitudinally wrinkled and light grey, as a rule uniformly leafy. *Innovations* rusty-tomentose, very soon glabrescent, older parts ultimately quite glabrous. *Leaves* variable in size and shape, but usually obovate, obovate-oblong or obovate-cuneate, sometimes more oval or elliptic or obovate-oblanceolate, 2–6 (–7) cm. long and 1–3 (–4) cm. wide, rarely narrowly lanceolate, 2·5–6 cm. long and 4–9 mm. wide, more or less thinly coriaceous, usually drying very dark brown and shiny above, pale brown and dull beneath, sometimes drying grey above; the apex obtuse or rarely subacute, sometimes rounded, but mainly in the obovate-cuneate type of leaf) not infrequently with a short, blunt acumen, tapering at the base, which is always acute or subacute, and with minutely reflexed margins; midrib almost flush above, slightly prominent beneath; secondary nerves ascending at an angle of $\pm$ 45°, rather straight, but very few reaching the leaf margin without brancing, joining other veins or slightly deflexing in the points where the tertiary nervations join them, archingly joining near the margin; tertiary veins forming a rather fine distinct reticular nervation which is usually very conspicuous in dried leaves and slightly prominent, at least on the lower surface. *Petioles* comparatively slender, terete, channelled above near the leaf-base, 3–9 mm. long. *Flowers* white, fragrant, solitary or in twos in the leaf axils on 1–3 (usually 1·5–2) cm. long, brownish-tomentose, slender and suberect or patent, usually not distinctly drooping pedicels; flower buds usually $\pm$ 1 cm. long just before opening. *Outer sepals* (6–) 8–12 mm. long and 3–3·5 mm. wide, shortly rusty-tomentose with a very narrow whitish or pale-grey edge, narrowly ovate-lanceolate, acuminate; inner sepals slightly shorter and narrower, with a pale grey or whitish tomentum and minutely ciliate, soon reflexed. *Corolla-tube* short, 1 mm. long; the 8 lobes linear-lanceolate or

narrowly oblong, ± 1 cm. long, rarely smaller (6–8) mm., the lateral appendages about as long, usually more acute than the lobes. *Filaments* thick, 1–2·5 mm. long, much shorter than the sagitate-oblong, or linear oblong, apiculate, 3–6 mm. long anthers. *Staminodes* long-triangular or lanceolate-subulate from a broad base, villous outside, shorter than the stamens but longer than the filaments. *Ovary* ovoid or oblong-ovoid, ± 2 mm. high, densely pilose; style glabrous, terete, slender, longer than the corolla and up to ± 12 mm. long, slightly tapering towards the apex which is truncate and often subcapitellate. *Fruiting pedicels* somewhat incrassate; calyx under fruit persistent, reflexed or ultimately deciduous. *Fruit* ovoid or ovoid-acuminate, 2–3·5 cm. long, 1–2 cm. in diam., often 1-seeded, ultimately glabrous, smooth, orange-red or yellow when ripe. *Seed*, when single, 2–2·5 cm. long, 8–10 wide and 6–8 mm. thick in the centre, oblong, with rounded apex and obliquely truncate-notched base, often distinctly keeled on the side above the small, circular, ± 2 mm. wide scar, but if more seeds are present in one fruit, often smaller and ± irregularly shaped, flattened and less distinctly truncate-notched or keeled; testa brown, shiny.

General Distribution.—From the Eastern Cape eastward and northwards into Natal, Swaziland, Zululand, Eastern Transvaal and Portuguese East Africa (possibly extending into tropical East Africa, because several species described from that area appear very similar from the descriptions, but no actual specimens seen) in evergreen forests in frost-free areas, mainly at low to fairly low altitudes.

Cape Province.—Alexandria: Olifantshoek, *Ecklon & Zeyher* (S, lecto., PRE, GRA isos); *Zeyher* (PRE), *Ecklon & Zeyher* or *Zeyher* (SAM). Bathurst: *Acocks* 11139 (PRE); Kariega Mouth, *Acocks* 18348 (PRE); Port Alfred, *Britten* 1681 (GRA, PRE). Albany: near Grahamstown, *MacOwan* 258 (GRA, HN, BOL, SAM); *Galpin* 179 (GRA, PRE); Beggar's Bush Forest Reserve, *Archibald* 5966 (PRE); Blaauwkrantz, *Britten* 897 (GRA, PRE); Paradise Kloof, *Story* 3128 (PRE). Stutterheim: *Sim* 2273 (or 21922?; NU); *Acocks* 8939; *Story* 1242. King William's Town: Pirie, *Sim* 1333 (NU); *Ross* s.n. (SAFD No. 1903). East London: *Galpin* 3164 (GRA, PRE), 9518, 10432 (PRE); *Smith* 3783, 3818 (PRE); *Sim* 2189 pp. (NU). Komgha: *Flanagan* 249 (PRE, BOL, SAM). Kentani: *Pegler* 765 (PRE, BOL, GRA, NBG); Qolora, *Edward* in h. Moss 17544 (J). Engcobo: Manina, *Zahn* 22, v.d. Merwe FD No. 2200 (SAFD). Ngqeleni: Qokama, *Acocks* 13426 (PRE). Port St. Johns: near Port St. Johns, *Moss* 4686 (J); *Boshoff* FD No. 5032 (SAFD). "Pondoland": Egossa and Port St. Johns, *Sim* 2418 (NU, PRE). Lusikisiki: *Acocks* 13426 (PRE), Miller FD No. 5771 (SAFD). Flagstaff: *R. C. Coloured School* s.n. (GRA).

Natal.—Port Shepstone: "South Coast Natal", *Pole Evans* 761 (PRE); Southbroom, *Codd* 9705 (PRE). Umzinto: Dumisa, *Rudatis* 1136 (L, PRE, isos of *M. rudatisii* Engl. et Krause). Umlazi: Park Rhynie, "*Indian collector*" s.n. (NH No. 14819); Winkle Spruit, *Van der Bijl* s.n. (NH No. 16136). Durban: Isipingo, *Ward* 342 (NU), 503 (NU, PRE); near Durban, *Wood* 5797 (BOL), 9112 (PRE); *Gerrard & McKen* 720, 869 (NH); *Rogers* 24502 (PRE); *Stayner* 20 (BOL); *Wylie* s.n. (= 23114, also PRE); Inanda, *Wood* 683 (BOL, NBG, isos of *M. woodii* Engl.); Umgeni Dam, *Bayer* 1387 (NU, NH, PRE, BOL). Pine Town: Marian Hill, *Forbes* 1039 (NH). Verulam: Umhloti Beach, *Codd* 1499 (PRE). Kranskop: Jameson's Drift, *Bayer* 540 (NU). Msinga: Nogbeva, *Edwards* 878 (PRE, NU). Nkandla: Middeldrift, *Edwards* 1423, 1424 (PRE, NU). Eshowe: *Lawn* 666 (NH); *Gerstner* 1922 (PRE), 2262, 2440 (NH, PRE), 2819 (BOL), 2994 (NH); Entumeni Waterfall, *Wylie* s.n. p.p. (NH No. 12940, the remainder is *M. caffra*). "Tugela": *Gerrard* 1642 (= iso. of *oleifolia* N. E. Br., NH). Mtunzini: near Mandeni, *Edwards* 1616 (PRE, NU). Lower Umfolozi; Umfolozi Game Reserve, *Ward* 3159 (PRE); *Kluge* 19 (NH); *Mtonjaneni*: *Gerstner* 3675 (NH, PRE); Empangeni, *Gerstner* 2767 (NH), 2730 (NH, BOL, PRE). Hlabisa: Hluhluwe, *Ward* 1700 (PRE); Masimba Hill, *West* 2078 (NH, PRE); Hlabisa

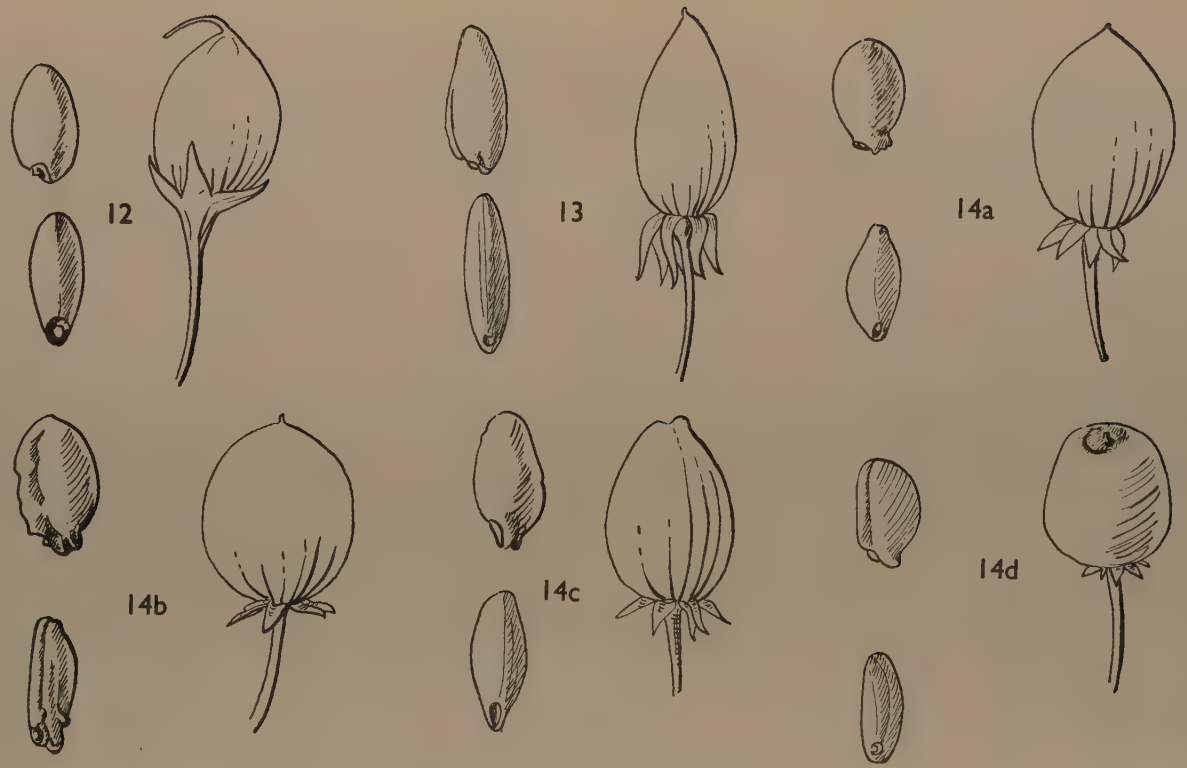


FIG. 12.—*Mimusops caffra*, seed and fruit (from *Howlett* 44, Kentani, E. Cape).

FIG. 13.—*Mimusops obovata*, seed and fruit (from a 1-seeded fruit of *Pegler* 765, Kentani, E. Cape). *N.B.*—Seeds of fruits with 2 or more seeds are often smaller and more or less deformed.

FIG. 14.—*Mimusops zeyheri*, seeds and fruits: (*a*) from *Codd* 3023 (Zoutpansberg, Transvaal), (*b*) from *Smuts & Gillett* 3286 (Zoutpansberg), (*c*) from *Lam & Meeuse* 4824 (Buffelspoortdam, nr. Pretoria, not far from the type locality!), (*d*) from a specimen without collector or locality, named *M. kirkii* in PRE, (*e*), figure on p. 353, from *O. B. Miller* B/220 (Molepolole, Bechuanaland Prot.). Note the variation in size and shape of fruits and seeds.

or Umbombo: near northern end of St. Lucia Lake, *Gerstner* 4987 (PRE). Nongoma: Wendelane Kloof, *Gerstner* 4659 (PRE, NBG). Ngwavuma: *Bayer* 760 (PRE). Natal without precise locality: *Gueinzuis* (original syntype gathering, presumably from the vicinity of Durban, in SAM); *Cooper* 1241 (BOL, NH, PRE).

SWAZILAND.—*Stewart* s.n. (TRV No. 8824 in GRA, PRE); Ubombo Mts. near Stegi, *Keith* s.n. (PRE).

TRANSVAAL.—Sebasa: Phephidi River (prob. near Phephidi Falls), *Legat* 1 (SAFD). Letaba: Patatabos, *Botha* s.n. = FD. No. 7154 (SAFD, PRE); The Downs, *Renny* DB 52 (PRE); De Hoek, *Keet* FD No. 7413 (SAFD).

PORTUGUESE EAST AFRICA.—Sul do Save: Lourenço Marques, *Gomes e Sousa* 3859 (COI, PRE).

N.B.—The specimen mentioned in Fl. Cap. 4, 1: 442 from Warmbaths, Transvaal (*Burtt Davy* 2625) is not *M. obovata* Sond., but *M. zeyheri* Sond.

The shape of the leaves of one specimen is usually fairly uniform but the various forms described as *M. oleifolia* N.E. Br., *M. woodii* Engl. and *M. rudatisii* Engl. & Krause, are, in my opinion, only ecotypes, as was already suggested by Gerstner. The forest form has rather thin leaves which are large and obovate, and corresponds with the descriptions of *M. obovata* and of *M. woodii*; a depauperate form growing in rocky places in the sun, has small coriaceous leaves, flowers more freely and corresponds with the narrow-leaved *M. oleifolia*. Not only are all these forms linked up in the herbarium by intermediate specimens, but the flowers, branches, pedicels, fruits and seeds are also identical.

A type specimen was not defined, because Sonder mentions the numbers *Gueinzius* 583 and 101 ex parte from Durban, and Ecklon & Zeyher's " Sideroxylon No. 16 " from Olifantshoek. The *Ecklon & Zeyher* collection being the best known and better represented in various herbaria, I propose the E. & Z. specimen in herb. Sonder (S) as the lectotype.

3. **M. zeyheri** *Sond.* in Linnaea 23: 44 (1850); Engl., Mon. Sapot. Afr. 73, t. 27, Fig. C (1904), incl. var. *laurifolia* Engl.; Wright in Dyer, Fl. Cap. 4, 1: 441 (1906); Gerstner in J. S. Afr. Bot. 12: 54 (1946); Meeuse in R. A. Dyer, Fl. Pl. Afr. 30: t. 1164 (1954), type: *Zeyher* 1130 in herb. Sonder, holo., BOL, NBG, isos.! *M. kirkii* Baker in Oliv., Fl. Trop. Afr. 3: 567 (1877); Engl., op. cit. 67; Gerstner, op. cit., 55, type: *Kirk* s.n. from Lower Shire Valley and *Kirk* s.n. from Rovuma in K, syns. *M. monroi* Sp. Moore in J. Bot. 49: 55 (1911); type: *Monro* 761 in BM, holo; BOL, SRGH, isos!

A tree reaching a height of at least 10–15 m., with spreading branches and a leafy, umbrageous canopy, but often appearing as a large shrub. *Innovations* densely adpressed rusty-tomentose, the twigs often retaining the pubescence for some time, the leaves sometimes in the form or irregular, powdery patches or along the midrib; branches, petioles and leaves ultimately glabrous. *Leaves* coriaceous or thinly coriaceous, shiny above, paler beneath, usually drying a pale greyish-green (young ones drying dark brown above, brownish-grey beneath), ovate-lanceolate to oblong-ovovate, sometimes obovate or broadly elliptic, sometimes broadly lanceolate, usually obtusely acuminate or gradually tapering into the obtuse or more rarely slightly emarginate, occasionally rounded apex, tapering, acute or subacute at the base, with slightly thickened and subreflexed margin, 4–9 (–11) cm. long (on coppice shoots occasionally up to 15 cm. long) and 2–4 (–5) cm. wide, on a (10–) 15–35 mm. long, terete, petiole which is rather firm, narrowly canaliculate at least near the leaf-base and not infrequently shows vestiges of the original reddish-brown tomentum; midrib forming a fine keel above, prominent below, very gradually tapering towards the apex of the leaf; lateral

nerves ascending at an angle of 45°–60°, usually not reaching the margin without branching, joining or deflexing, archingly joining near the edge of the leaf, not or hardly distinct from the tertiary nerves, the latter first more or less parallel to secondary ones, then becoming irregular, forming a rather coarse reticulate meshwork filled up by a finer reticulate nervation; secondary and tertiary nerves usually conspicuous, slightly raised, finer nervation often inconspicuous. *Pedicels* often numerous on the twigs in fascicles of 3 or more in the leaf axils, sometimes only 1–3 per axil, 10–30 mm. (but almost invariably between 15 and 25 mm.) long, rusty-pubescent, recurved, not lengthening but slightly incrassate (up to ± 1·5 mm. thick) in fruit. *Flower-buds* just before opening 5–7 mm. long and 3–4 mm. thick. *Sepals* long-triangular to ovate-lanceolate, acute; the outer ones rusty-pubescent often with a narrow pale edge, 5–6 (–7) mm. long and 2–3 mm. wide, the inner ones pale greyish-white tomentose, slightly shorter and narrower. *Corolla*-lobes about equalling the calyx, about 6 mm. long, linear-lanceolate, acute, their appendages about or long as shorter (4–6 mm.), linear-lanceolate and acute. *Anthers* elongate-sagittate, apiculate, about 3·5 mm. long on subulate, 1·5 mm. long filaments. *Staminodes* long-triangular or triangular-lanceolate, either shorter than the stamens and acute, or longer than the stamens and long-acuminate to nearly aristate, densely pilose outside. *Ovary* globose or ovoid, about 2·5 mm. long, villous, attenuated into a 5–10 mm. long style, the latter glabrous, terete, longsubulate, tapering towards the apex. *Fruiting calyx* not accrescent, somewhat spreading but not quite reflexed as a rule. *Berry* ovoid, ellipsoid or almost spherical, 2–3 cm. long, 1–2·5 cm. diam, sometimes smaller, glabrous and yellow when ripe, usually crowned by the persistent style (at least when young), with mealy, edible pulp, 1–4 seeded. *Seeds* obovate or elliptic, compressed, usually 15–20 mm. long, 9–12 mm. wide and 4–5 mm. thick, sometimes considerably smaller; often (especially when only 1 or 2 seeds are present) more or less laterally produced or at any rate somewhat attenuated at the base; the scar nearly basal, almost horizontal, in a hollow sinus; testa light brown, shiny.

General Distribution.—Bechuanaland, Transvaal, Swaziland, Portuguese East Africa, Rhodesia and extending into tropical East Africa.

Bechuanaland.—Gaberones, *Van Son* s.n.; Kanye, *O. B. Miller* B/298; Lobatsi Govt. Farm, *O. B. Miller* B/245 (PRE); Molepolole, *O. B. Miller* B/220 (PRE); Chobe Riv. nr. Serondela, *O. B. Miller* B/337 (PRE).

Transvaal.—Marico: *Louw* 610; Zeerust, *Thode* A1438. Rustenburg: Rustenburg, *Sutton* 885, 885a, 1023; *Phillips* s.n.; *Phillips & Schweickerdt* 3550; *Rose-Innes* 1 (PRE); Pretoria, Brits and Magaliesberg Range: *Zeyher* 1130 (BOL, SAM, isos!); *Burke* 72 (PRE, SAM, for practical purposes duplicates of *Zeyher* 1130); *Leendertz* s.n. 949; *Galpin* 6975; *Lam & Meeuse* 4824 (L); *Meeuse* 9095, 9095a; *Hutchinson & Mogg* 2905. Johannesburg: Modderfontein, *Putterill* 161. Middelburg: Olifants Riv. Gorge, *Mogg* 22447. Warmbaths: Warmbaths, *Burtt-Davy* 2149, 2625; *Galpin* 8853. Waterberg: Nylstroom, *Prosser* 1753, Rietspruit, 40 miles NNW of Vaalwater, *Smuts* 362. Potgietersrust: *Galpin* 8823, 9023; *Smuts* 2006, Pietersburg: Blaauwberg, Leipzig, *Bremekamp & Schweickerdt* 1118; Daviesville, Setali, *Gerstner* 5429; Woodbush, *Hoffmann* 30; De Hoek Forest Reserve, *Keet* h. No. FD 7413. Zoutpansberg: near Louis Trichardt, *Obermeyer, Schweickerdt & Verdoorn* 361a; *Hutchinson* 2004; *Rodin* 3987; *Rogers* 2177; Hanglip, *Gerstner* 5994; 20 miles NW of Louis Trichardt, *Codd* 3023; Happy Rest, *Gerstner* 6031; 10 miles E. of L. Trichardt, *Gerstner* 5731; Tshakoma, *Obermeyer* 1092; ± 10 m. W. of Wyllie's Poort, *Gerstner*

5923 (PRE). Sebasa: Phepidi Falls, *Smuts & Gillett* 3308, 3286; *Curson & Irvine* 55, 109; *Legat* 4819; Kruger National Park, near Pafuri, *v. d. Schijff* 578, 3812; id., Punda Maria, *Lang* s.n.; *Codd* 6514; *v. d. Schijff & Marais* 3728. Letaba: Duiwelskloof, *Gerstner* 5881. Lydenburg: Sekukuniland, *van Warmelo* 94; *Mogg* 16916 (PRE); *Barnard & Mogg* 762; *Barnard* 13 (PRE). Pilgrims Rest: Mariepskop, *Scheffler* FD herb. No. 9946 (SAFD); Lothian, FD herb. No. 890 (SAFD). Nelspruit: Kruger National Park, Numbi: *van der Schijff* 25; near Sabin, *Codd* 4409 *van der Schijff* 696, 1461 Barberton: *Thorncroft* 2177; *Liebenberg* 2630; *Burtt-Davy* 2810.

Swaziland.—Lebombo Mts., *Hornby* 2805; Stegi, *Codd & Dyer* 2910, *O. B. Miller* S/76; *Acocks* 15350.

Portuguese E. Africa.—Sul do Save: Guija, *Myre & Balsinhas* 788 (PRE); *Pedrogão* 262 (PRE); *Pedro & Pedrogão* 2974 (PRE) Chegua, Chongoene, *Gomes e Sousa* 3999 (PRE); Matola, Imputa River, *Mogg* s.n. (PRE); Macovane, *Hornby* 2714 (SRGH, PRE). Manica e Sofala: Serra da Gorongoza, *Simão* 952 (PRE); " á milha 25 da T.Z.R.", *Simão* 818 (PRE); Lifumba (Mutarara), *Simão* 1488 (LM). Zambezia: Mocuba, Namagoa, *Faulkner* 56 (PRE, COI); betw. Régulo Ingive and Nante, *Barbosa & Carvalho* 4203 (PRE). Niassa: Pto. Amelia, btw. Mocimboa da Praia and Palma, *Barbosa* 2122 (PRE).

S. Rhodesia.—Bulalima–Mangwe: Plumtree, *Davies* 280 (SRGH); Mangwe, Marula, *Plowes* 1309 (SRGH, PRE). Bulawayo: Matopos, *O. B. Miller* B/1257 (PRE), *Mundy* 892, 904, 909 (SRGH); *Plowes* 1331 (SRGH, PRE); *West* 2941 (SRGH); *Orpen* 049/50 (SRGH); *Borle* 45 (PRE); *West* 2494 (SRGH). *Belingwe*: *Harvie* 9/51 (SRGH); 9/51 (SRGH); *West* 2792 (SRGH); Nuanetsi: Matibi I Reserve, *Davies* 1773 (SRGH, PRE); Ft. Victoria: *Eyles* (?) in SRGH No. 3863; N.N. 52/51 in SRGH No. 34663; *McGregor* 2/47 (SRGH); *Acheson* 13 (SRGH); *Monro* 690 BOL); 761 (SRGH, BOL isos of *Mimusops monroi* Sp. Moore); Zimbabwe, *Hornby* 2831 (PRE); *Smuts* s.n. (PRE); *Gerstner* 6987 (PRE); *Seward* 47/51 (SRGH); *Seymour-Hall* 3/51 (SRGH) Chilimanzi: *Wormold* 21/51 (SRGH); *Mylne* 1/51 (SRGH); *Kirkham* 18/51 (SRGH); *Gibson* 5/51 (SRGH); *Greenhow* 24/51 (SRGH, PRE). Sabi-Lundi: *Wild* 3353, 3377 (SRGH, PRE). Ndanga: *Chase* 2338 (SRGH, PRE), 2416 (SRGH). Gwelo: *Eyles* 5555 (SRGH); leg. *Eyles* (?) (SRGH No. 3331); *Steedman* 210 (SRGH). Hartley: *Hornby* 3230 (SRGH); *Jack* s.n. (SRGH No. 4082); Umniati Riv., *Mills* 5/47 (SRGH). Umtali: *Obermeyer* 2070 (PRE); *Chase* 317, 1314, 1531 (SRGH), 869 (SRGH, PRE). " Eastern Border ": *Chorley* s.n. (SRGH No. 3685). Vumba Mts.: *Chase* 1741 (SRGH). Salisbury: Concession, *Eyles*? in SRGH No. 1124. Mazoe: *Eyles* 4773 (SRGH); *Mundy* s.n. (SRGH No. 2090); *Ford* s.n. (SRGH No. 5146). Lomagundi: *Eyles* 2689, 2715 (SRGH, PRE, SAM), 3130 (SAM, PRE) 4971, 4973 (SRGH) *Pardy* s.n. (SRGH Nos. 5918, 5924). " Zambesi ": *West* 2900 (SRGH). Urungwe: *Lovemore* 291, 361 (SRGH, PRE). Victoria Falls: Flanagan 3302 (BOL); *Galpin* 7044 (GRA, PRE, BOL), 14999 (PRE); *Rogers* 5310 (GRA, BOL, SAM); 7446 (J); *Schwartz* s.n. (BOL 25012); *Rodin* 4492 (PRE, SRGH); *Wild* 3130 (SRGH); *Greenway* 6250 (PRE), *Poynton* 12 = FD herb. No. 10403 (SAFD).

Northern Rhodesia.—Nega-Nega Hills: *Burtt Davy* 762 (PRE).

Nyasaland.—Likubula Gorge: *Brass* 16366 (= Vernay Nyasaland Exp. 1946) (PRE).

As regards the identity of *M. zeyheri* Sond and *M. kirkii Baker* the following "differences" can be found in the original descriptions (see also Engler, op. cit.):

	M. zeyheri.	*M. kirkii.*
Pubescence:	Young parts rusty-tomentose.	Twigs nearly glabrous.
Leaf:	Blade coriaceous, ultimately glabrous, oblong, obtusely acuminate, more or less narrowed at the base with distinct lateral veins, 7½–9 cm. long, 2½–3½ cm. wide, on a 16–20 mm. long petiole.	Blade coriaceous, glabrous, obovate-oblong, obtuse, cuneate at the base, with fine main veins, 5–10 cm. long, 3–4½ cm. wide on a 15–25 mm. long petiole.
Flowers:	Pedicels in fascicles of 3 or more, 12–18 mm. long, recurved, staminodes shorter than the stamens; (according to Engler's key): lateral appendages shorter than corolla-lobes; style short.	Few together, on 12–20 mm. long arching pedicels; staminodes about as long as the stamens (according to Engler's key): lateral appendages about as long as corolla-lobes; "style much exerted from the corolla".
Fruit:	Ellipsoid, glabrous, an inch long, seed obovate, compressed, subproduced at the base.	Globose, glabrous, an inch long; seed?

These differences appear to be very slight, and the most important ones seem to be the length of the lateral appendages, the length of the style and the shape of the fruit. However, subequal corolla-lobes and appendages can be found occuring with short staminodes and with longer ones, with short styles and with longer ones. The fruits in *M. zeyheri* vary from globose to ovoid and the seeds of fruiting specimens referred to *M. kirkii* (including the fruiting type specimen) in various herbaria show the characteristic produced base reported for *M. zeyheri*. Mr. B. de Winter compared specimens of *Mimusops* from the Transvaal with the type of *M. kirkii* and with authentic specimens of *M. zeyheri* at Kew and some of them correspond with either form, but there are intermediate specimens which link them up. The Rhodesian material I saw shows a complete continuous transition from the narrow leaved forms (= *M. zeyheri*) to the broad-leaved forms (= *M. kirkii*), and the rusty pubescence of the innovations occurs in both forms. In my opinion the form which corresponds with *M. zeyheri* is the Bushveld ecotype and often shrubby, whereas the broad-leaved form is a Lowveld ecotype (more tropical hence large trees), but there is no question about their specific identity.

Mimusops monroi S. Moore is a narrow-leaved form of "typical" *M. zeyheri*. Mr. de Winter kindly compared the type of *M. monroi* (*Monro* 761 in BM) and reported that it is an almost perfect match of *Burke* 72 from the Magaliesberg (in herb. Kew), which number is a "twin-type", practically identical with *Zeyher* 1130, the type of *M. zeyheri*, so that there is no doubt about the conspecifity of both species. Duplicates of *Monro* 761 in BOL and SRGH which I have seen are indistinguishable from most Transvaal specimens and certainly conspecific.

EXCLUDED SPECIES OF MIMUSOPS.

Mimusops altissima Engl. = *Muriea* spec. [an *Muriea discolor* (Sond.) Hartog?], see p. 379.

M. angolensis Engl. = *Manilkara cuneifolia* (Baker) Dubard (a duplicate of the type, *Welwitsch* 4836 in COI, was studied).

M. buchananii Engl. = *Muriea* spec. (an *M. discolor*?, see p. 379).

M. concolor Harv. ex Wright = *Manilkara concolor* (Harv. ex Wright) Gerstner.

M. cuneata Engl. = *Austromimusops cuneata* (Engl.) A Meeuse, see p. 355.

M. cuneifolia Baker = *Manilkara cuneifolia* (Baker) Dubard.

M. densiflora Baker = *Manilkara multinervis* (Baker) Dubard (t. Engler and Hutch. & Dalz.)

M. densiflora Engl. non Baker = *Manilkara mochisia* (Baker) Dubard, see p. 369.

M. discolor (Sond) Hartog = *Muriea discolor* (Sond.) Hartog, see p. 344.

M. dispar N.E. Br. = *Austromimusops dispar* (N.E. Br.) A. Meeuse, see p. 352.

M. fischeri Engl. = *Manilkara* spec., prob. *M. mochisia* (Baker) Dubard.

M. henriquesiana Sim = *Lecomtedoxa henriquesii* (Engl. et Warb.) A. Meeuse, see p. 344.

M. henriquesii Engl. et Warb. = *Lecomtedoxa henriquesii.*

M. klaineana (Pierre ex) Engl. = *Lecomtedoxa klaineana* (Engl.) Dubard.

M. macaulayae Hutch. et Corb. = *Manilkara macaulayae* (Hutch. et Corb.) H. J. Lam, see p. 373.

M. marginata N.E. Br. = *Austromimusops marginata* (N.E. Br.) A. Meeuse, see p. 348.

M. menyhartii Engl. = *Manilkara mochisia* (Bak.) Dubard, see p. 369.

M. mochisia Baker = *Manilkara mochisia* (Bak.) Dubard.

M. natalensis (Pierre) Engl. non *M. natalensis Schinz* = *Muriea discolor*, see p. 377.

M. natalensis Schinz = *Austromimusops marginata* (N.E. Br.) A. Meeuse.

M. schinzii Engl. = *Austromimusops marginata* (N.E. Br.) A. Meeuse.

M. spiculosa Hutch. et Corb. = *Manilkara macaulayae* (Hutch. et Corb.) H. J. Lam.

M. silvestris S. Moore = *Austromimusops silvestris* (S. Moore) A. Meeuse, see p. 354.

" *M. transvaalensis* Schinz " (sphalm.) ex Radlk. (recte: *natalensis*) = *Austromimusops marginata* (N.E. Br.) A. Meeuse.

M. umbraculigera Hutch. et Corb. = *Manilkara macaulayae* (Hutch. et Corb.) H. J. Lam.

M. welwitschii Engl. = *Manilkara cuneifolia* (Baker) Dubard.

M. zanzibarensis Engl. = *Manilkara zanzibarensis* (Engl.) Dubard.

8. MANILKARA.

Adans. emend. Gilly in Trop. Woods 73: 1–22 (1943); Lam & Royen in Taxon. 2, 5: 112 (1953); Royen in Blumea 7: 401 (1953), nomen conserv. propos.

Manilkara Adans., Fam. Pl. 2: 166 (1763); Dubard in Ann. Mus. Col. Marseille 23: 6 (1915); Baehni in Candollea 7: 462 (1938); Lam in Blumea 4: 323 (1941).

Mimusops pro parte, A.DC. in DC., Prodr. 8: 203 (1844) (quoad sect. *Ternaria* ADC.); Bentham & Hook., Gen. Pl. 2: 661 (1876); Baker in Oliv., Fl. Trop. Afr. 3: 505 (1877); Engl., Mon. Sapot. Afr. 55 (1904) (quoad section *Euternaria* Engl. exclus. *Muriea*); Wright in Dyer, Fl. Cap. 4, 1: 439, 1906; Phillips, Gen. S. Afr. Fl. Pl. ed. 2, 568 (1951).

Trees or large shrubs. *Stipules* caducous or none. *Leaves* usually crowded at the tips of the branches; often more or less oblong-obovate with rounded (and emarginate) apex; lower side often lighter than upper one, mesophyll with sclereids; the nervation is usually parallel (tertiary nerves parallel to secondary ones), often causing a striate appearance of the leaf. *Flowers* axillary, usually in the axils of the lower leaves of the branches or of the scars of fallen leaves, 3-merous or occasionally 4-merous. *Sepals* biseriate, 3 + 3 (or 4 + 4), often rather broad. *Corolla* 6- (or 8)– lobed, each lobe (in the South African species) with two dorsal appendages. *Stamens* 6 (or 8), inserted in the throat of the corolla tube; filaments usually longer than the rather small anthers. *Alternipetalous staminodes* 6 (or 8), or sometimes fewer than the number of stamens, but never absent, usually small, often more or less dentate, lobed, fimbriate or divided, glabrous; not incurved and not covering the style as in *Mimusops*, but erect with the stamens of reflexed with the corolla. *Ovary* 6– (or 8)-loculated, sometimes up to 15-loculated; ovules ventrally or basiventrally attached. *Berry* one- to several-seeded. *Seeds* more or less laterally compressed; testa crustaceous, brittle, or hard and bony; scar ventral, long and narrow, or basiventral and rather large and wide, rarely small, basal; endosperm copious, cotyledons thin, foliaceous.

Type species: *Mimusops kauki* L., Sp. Pl. ed. 1, 349 (1753) = *Manilkara kauki* (L.) Dub. in Ann Mus. Col. Marseille 23: 9 (1915), fide Van Royen in Blumea 7: 402.

Distribution.—Circumtropical; about 25 species in tropical America, about 30 in tropical Africa, South Africa and the Mascarenes and about 15 in the Far East and Pacific islands.

Manilkara is now almost universally recognised as a distinct genus. For a detailed discussion of the differences between this genus and *Mimusops*, cf. Lam., op. cit., 345–347. For the area under discussion, the main differences are given in Table II.

Both *Manilkara* and *Mimusops* have alternipetalous staminodes (which distinguish these two at once from *Muriea*, which has either 12 fertile stamens and no alternipetalous staminodes, or 12 sterile stamens), and both have seeds with endosperm, which distinguishes the two from *Austromimusops* apart from the very large seed scar in the latter. Gilly, in Trop. Woods 73 (1943), p. 1–22, extended the genus *Manilkara* by including *Achras* L. This would mean that *Manilkara* Adans. (1763) has to be replaced by *Achras* L. (1753) and all the old world species of *Manilkara* apart from the American ones would have to be renamed. Gilly's interpretation is accepted by Lam and Van Royen who drew the consequences and proposed that it would be better to conserve *Manilkara* against *Achras* (see Taxon 2, 5: 112). In anticipation of adoption of this proposal for conservation, I retain the African representatives in *Manilkara*.

Twigs slender, not conspicuously zig-zag, divaricate or subverticillate; leaves not congested at the *very* tips of the branches;

Sepals 5–6 mm. long; staminodes about as long as the stamens, not fleshy, more or less irregularly serrate, incised or lacerate; leaves often more than 6 cm. long and over 2·5 cm. broad; petioles often more than 1 cm. long..... 1. *M. zanzibarensis*.

Sepals about 3·5 mm. long; staminodes usually shorter than the filaments, more or less fleshy, occasionally with a long apical filamentous portion; leaves usually less than 6 cm. long and 2·5 cm. broad; petioles 5–8 mm. long..... 2. *M. concolor*.

Twigs thick, conspicuously zig-zag, divaricate or subverticillate; leaves almost invariably crowded in fan-like groups at the very tips of the branches or on short lateral side-shoots; small trees resembling species of *Terminalia:*

Leaves quite glabrous, young ones very soon losing their pubescence; pedicels 8–12 mm. long, sparingly pubescent; sepals sparsely pubescent outside..... 3. *M. mochisia*.

Leaves usually retaining vestiges of the dense pubesce of the young leaves, at least near the midrib or towards the base, rarely becoming quite glabrous; pedicels often more than 12 mm. long; sepals tomentose outside..... 4. *M. macaulayae*.

1. **M. zanzibarensis** (*Engl.*) *Dub.* in Ann. Mus. Col. Marseille 23: 26 (1915); Brenan & Greenw., Tanganyika Terr. Check List. *Mimusops zanzibarensis* Engl. in Pflanzenw. O. Afr., C, 307 (1895), and in Mon. Sapot. Afr. 58, t. 21, Fig. B (1904), type: *Stuhlmann* coll. No. 1, 1009 in B, holo†, from Zanzibar.

A large shrub or small tree up to 15 mm. high. *Branches* terete, glabrous, faintly longitudinally striate or sulcate, the ultimate ones rather uniformly leafy. *Leaves* elliptic, or obovate-oblong to (elliptic-) oblong, 3–12·5 cm., but usually 6–10 cm., long, 2–5 cm. wide, coriaceous, rather opaque but sometimes shiny with a greyish or silvery shine beneath, glabrous, obtuse, rounded or sometimes emarginate at the apex, acute at the base, with distinctly reflexed margin; midrib immersed but often more or less keeled above, very prominent and when dry longitudinally finely striate or sulcate below; secondary nerves numerous (16–25 on either side), slender, impressed hence conspicuous above, far less conspicuous beneath, straight or ascending; tertiary nerves parallel to secondary ones, but somewhat thinner and often shorter; ultimate nervation fine, reticulate, immersed and conspicuous above, less conspicuous beneath. *Petioles* stout, terete, canaliculate above, 0·5–3·5 but usually 1·2 cm. long, glabrous, in dried specimens more or less sulcate or striate below. *Flowers* trimerous, in fascicles in the axils of the leaves or of leaf-scars, few or many together; pedicels 5–8 mm. long, more or less angular, densely and shortly rusty-pubescent. *Sepals* ovate-oblong to oblong, acute, 5–6 mm. long; the outer ones about 3 mm. wide, shortly rusty-pubescent outside and whitish-pubescent inside near the margins and near the apex, with a broad base; the inner ones thinner in texture, 2–3 mm. wide, whitish-tomentose outside and glabrous inside except near the very apex, ciliate along the margins, with a narrower base. *Corolla* white, glabrous; the tube 2 mm. long, the lobes linear-oblong, 4–5 mm. at the apex, sometimes bifid and the lobes variously incised, glabrous. *Filaments* long-subulate, ± 2 mm. long; anthers biapiculate, ovate-elliptic, about as long as the filaments. *Ovary* depressed semi-globose, about 10-loculated and more or less distinctly lobed, densely covered with greyish hairs, about 0·75 mm. high and about 1·5 mm. in diameter, very abruptly narrowing into the terete, glabrous, ± 5 mm. long, truncate style. *Fruit* (according to Engler) obovoid, 10 mm. long and ± 7·5 mm. in diameter, 2–4 seeded; seeds oblong, compressed ± 8 mm. long, with a short cicatrix above the base.

N.B.—The figure A of tabula 21, B in Engler's monograph (1904) is not correct in that the flowers are drawn far too small although the legend mentions natural size. The other figures are properly drawn to scale.

General Distribution.—Coast of East Africa, from Zanzibar southwards and extending into the province of Niassa, Portuguese East Africa.

ZANZIBAR.—Imp. For. Herb. 834 leg. *Vaughan* (PRE).

TANGANYIKA.—Mafia Island, *Greenway* 5013, 5356 (PRE).

PORTUGUESE E. AFRICA.—Niassa: between Macomia and Mipande near Pto. Amelia, *Barbosa & Lemos* 2302 (LM); between Mahate and Metuge near Pto. Amelia, *Barbosa* 2346 (LM).

2. **M. concolor** (*Harv.* ex Wright) *Gerstner* [sphalm. (" E. Mey) Gerstner "] in J. S. Afr. Bot. 14: 171 (1948).

Mimusops concolor Harv. ex Wright in Dyer, Fl. Cap. 4, 1: 443 (1906); type: *Gerrard & Macken* 1662 in TCD, holo, teste C. H. Wright, K. iso, from Zululand.

Although the combination " *Manilkara concolor* (Harvey) Gerstn. " was erroneously published by Gerstner by putting " E. Mey " as the original author, it is evident from some of his notes and names on labels in the National Herbarium, Pretoria, that he actually meant the combination " *Manilkara concolor* (Harv.) Gerstn. ", and he was credited as the author of this combination in the Index Kewensis.

A much branched large shrub or small tree, up to 15 m. but usually well under 10 m. high. *Branches* terete, greyish, more or less distinctly longitudinally fissured and with very prominent and large scars, the ultimate ones rather slender and almost invariably under 3 mm. in diameter, soon quite glabrous. *Innovations* glabrous or at least very soon quite glabrous. *Leaves* crowded at the ends of the twigs but not strictly terminal as in the next two species, varying from obovate-oblong or narrowly spathulate-oblong to oblanceolate-oblong, sometimes elliptic or elliptic-oblong, but usually narrowly spathulate-oblong or almost oblong (but with the greatest width just above the middle), 2–5 cm., rarely up to 8½ cm. long and 1–2 (–3·5) cm. wide, coriaceous, glabrous, with subreflexed margin an emarginate or retuse, rarely rounded apex, and narrowed, but never very acute, base; midrib slightly raised or subimmersed, flush or minutely keeled, but always narrow above, rather prominent below; secondary nerves very slender, inconspicuous or more or less conspicuous because they are impressed on both sides, 10–15 on either side, parallel, straight or rather straight, and ascending at an angle of 60°–90°; tertiary nerves rather few, parallel to but shorter than the secondary ones; ultimate reticulate tessellate nervation fine, immersed on both sides and as a rule distinct or conspicuous. *Petiole* semi-terete, flattened and channelled above, rather stout, 3–8 mm. long, glabrous. *Flowers* in the axils of the leaves and of scars of fallen leaves, fasciculate, often very numerous, 3-merous or sometimes 3-merous and 4-merous on one specimen; pedicels comparatively stout, terete or sub-glabrous, abruptly widening into the calyx, *Sepals* ovate or ovate-elliptic, obtuse, about 3·5 mm. long; the outer ones tomentose outside and inside near the apex, 2 2·5 mm. wide; the inner ones thinner, petaloid, slightly narrower, about 2 mm. wide, vaguely midribbed, whitish tomentose outside, glabrous inside. *Corolla* yellow or yellowish, glabrous; the tube 0·75–1 mm. long, the lobes oblong-linear or oblanceolate-spathulate, obtuse or rounded, with a very narrow, base, 3·3–5 mm. long and about 0·75 mm. wide; the appendages about as long and wide, but from a broad base lanceolate-linear, acute or acuminate, often with a few coarse serrations near the apex. *Staminodes* sometimes fewer than the number of calyx-lobes, glabrous, fleshy, usually ovate-suborbicular or subquadrate, and much shorter than the filaments, usually more or less trilobed or tridentate, occasionally some produced in a thin filiform apical portion equalling the filaments and if so, equalling or longer than the stamens. *Filaments* 1·5–2 mm. long, glabrous; anthers somewhat sagittate, apiculate, 1–1·5 mm. long. *Ovary* 6- (or 8-) loculated, semiglobose-conical, faintly lobed, hairy, nearly 1 mm. long and about 1·25 mm. in diameter, more or less gradually passing into the rather thick, subulate, glabrous and truncate, about 2·5 mm. long style. *Fruiting* pedicels not or hardly lengthened, somewhat incrassate; calyx persistent. *Berry* 1- or 2-seeded, edible, ellipsoid or subglobose, 10–15 mm. long and 8–15 mm. in diameter. *Seeds* obovoid, hardly compressed when single, often with one flattened lateral side when from a 2-seeded fruit, obliquely truncate at the base, 9–11 mm. long 6½–8 mm. wide, those from 1-seeded fruits 5–7 mm. thick, those from 2–seeded fruits 3–5 mm. thick; testa brown, smooth and shiny, hard; scar ovate, oblong or elliptic, occupying the truncate basilateral side of the seed, 6–8 mm. long and ± 3 mm. wide.

Natal.—Kranskop: Tugela near Jameson's Drift, *Bayer* 648 (NU). Mtonjaneni: Mtonjaneni, *Gerstner* 3710 (NH, PRE); Fule Drift near junction with Umhlatuzi, *Gerstner* 2735 (BOL). Lower Umfolozi: Umsindusi Bridge, *West* 1873, 1911 (NH); Empangeni, Nagana Res. St., *Kluge* 30 (NH); Umfolozi Game Reserve, *Ward* 1467 (NH, PRE). Hlabisa: Duku–Duku forest, *Forest Dept.* FD h. No. 8603 (Pre, SAFD); near Matubatuba, *Gerstner* 8974 (NH, PRE); Hluhluwe Game Reserve, *Ward* 1593 (NH, PRE); False Bay, *Gerstner* 4791, 5061 (NBG, PRE), 5235 (PRE). Nongoma: about 13 m. N. of Nongoma on road to Magut, *Acocks* 13015, *Codd* 1943 (PRE); Wendelane Kloof. *Gerstner* 2522 (BOL), 4683 (NBG, PRE). Ubombo: Mkusi, Galpin 13319 (PRE).

PORTUGUESE EAST AFRICA.—Sul do Save; Lourenço Marques distr., Maputo, Santaca, *Gomes e Sousa* 3799, 3819 (COI, PRE), 3861 (PRE).

3. **M. mochisia** (*Baker*) *Dub.* in Ann. Mus. Col. Marseille 23: 26 (1915); Gerstner in J. S. Afr. Bot. 14: 171 (1948), sphalm. "(Baker) Gerstner". *Mimusops mochisia* Baker in Oliv., Fl. Trop Afr. 3: 506 (1877); Engl., Mon. Sapot. Afr. 63, t. 22, Fig. B (1904); type: *Kirk* 304 from Tete, K, lecto.; fragment in PRE!.

Mimusops densiflora Engl., Pflanzenw. O.-Afr., C, 307 (1895), and in Mon. Sapot. Afr. 63, t. 22, Fig. C (1904), non Baker in Kew Bull. 1895: 148; type: *Stuhlmann* coll. No. 581 in herb. Hamburg, lecto.

Mimusops menyhartii Engl., op. cit. (1904), 63, t. 23, Fig. D; type: *Menyhart* 771 from Boruma in Z, holo., PRE, photo!.

" *Manilkara densiflora* Engl.", Dale, in Imp. Forestry Inst. Paper 18: 25 (1939); *M. densiflora* Dale, q.e. nom. nov., ex Brenan and Greenw., Check list Tanganyika Terr. 2: 563 (1949). *M. densiflora* (Engl.) H. J. Lam in Blumea 4, 2: 355 (1941), nomen illeg. *M. menyhartii* (Engl.) H. J. Lam, op. cit., 356.? *Sideroxylon fischeri* Engl. in Pflanzenw. O. Afr., C, 306 (1895). = *Mimusops fischeri* (Engl.) Engl., Mon. Sapot. Afr. 64 (1904). = *Manilkara fischeri* (Engl.) Lam in Blumea 4: 355 (1941).

A much branched deciduous large shrub or small to medium-sized tree, up to 10 m., rarely up to 15 m., high, with divaricate, subverticillate or zig-zag wise arranged, often crooked branches, resembling several African species of *Terminalia* in habit. *Branches* dimorphous; main shoots rather long (internodes usually 5–10 cm. long); " lateral " short branches usually under 20 mm. long; internodes of main shoots terete, rather smooth, finely longitudinally sulcate and, if not very young, glabrous and over 3 mm. thick, only the very young growing ones bearing a few leaves that are not strictly terminal. *Short shoots* and apices of the branches frequently somewhat thicker than the adjoining internodes, very rough with the scars of fallen leaves; youngest shoots at first pale yellowish- or whitish-tomentose, glabrescent. (New shoots are formed laterally under the terminal thickened and leaf-bearing portions of the branches and and this causes the peculiar divaricate or subverticillate branching, the original terminal portion becoming a short " lateral " branch). *Leaves* in rather dense, more or less fan-wise spreading groups on the short lateral branches and terminal apices (apparently both lateral and terminal thickened portions of the stems being able to produce young leaves during several season in succession); young leaves almost completely glabrous as soon as they appear, the older ones quite glabrous; blade narrowly elliptic-obovate, narrowly spathulate-oblong, cuneate-oblong or more or less oblanceolate-oblong, sometimes obovate-oblong, 1·5–4 (–6) cm. long and 0·75–2 (–2·75) cm wide, coriaceous, or subcoriaceous, with a usually distinctly emarginate or retuse, sometimes rounded, apex, and narrowing towards the base, with minutely reflexed margins, drying greyish-green, paler beneath; midrib usually not very prominent on either side, but as a rule flush or slightly immersed above and slightly prominent beneath, distinct and discolorous in dried specimens; lateral nerves slender, immersed, ascending at an angle of 45°–60°; secondary nerves rather numerous (10–15 on either side), tertiary nerves not or hardly discernible from the ultimate, fine, impressed, reticulate nervation. *Petioles* 2–4 mm., rarely up to 7 mm., long, flattened above, on either side minutely winged by a continuation of the leaf margins. *Flowers* trimerous (at least no 4–merous ones seen), often appearing with the young leaves or just before the leaves, solitary or in fascicles in the axils of fallen leaves below the young growths; pedicels and calyx greenish or green tinged with brown. *Pedicels* 8–12 mm. long, rather slender, more or less angular, sparingly whitish pubescent, abruptly widening into the calyx. *Sepals* 3 + 3; the

outer ones ovate, sometimes oblong, 4–5 mm. long, 2·5–3 mm. wide, sparingly pubescent outside, pubescent inside near the apex and margins; the inner ones more petaloid, oblong, 4–4·5 mm. long and 2–2·5 mm. wide, acute, tomentose outside, glabrous inside, vaguely midribbed. *Corolla* glabrous; the tube about 1 mm. long; the lobes elliptic-lanceolate from a narrow base, obtuse or rounded; about 4 mm. long and 0·75–1 mm. wide, the appendages about as long, linear, obtuse or rounded, 0·5–0·75 mm. wide. *Staminodes* variably in size but usually much shorter than the filaments, rather fleshy, subquadrate, ovate or spathulate, trilobed, tridentate, bifid or incised, occasionally produced at the apex in a long subulate or filamentous appendage equalling the filaments, rarely even longer. *Filaments* long-subulate, about 2·5 mm. long, anthers oblong, apiculate, about 1·5 mm. long. *Ovary* 6-loculated, semiglobose-conical, about 1 mm. high and about 1·5 mm. in diameter, densely covered with rather long hairs which also cover the base of the about 3 mm. long, subulate, terete, glabrous, truncate style. *Fruiting pedicels* hardly lengthened, somewhat incrassate, fruiting calyx persistent *Berry* ellipsoid or ellipsoid-obovoid, yellow when ripe, highly appreciated by natives

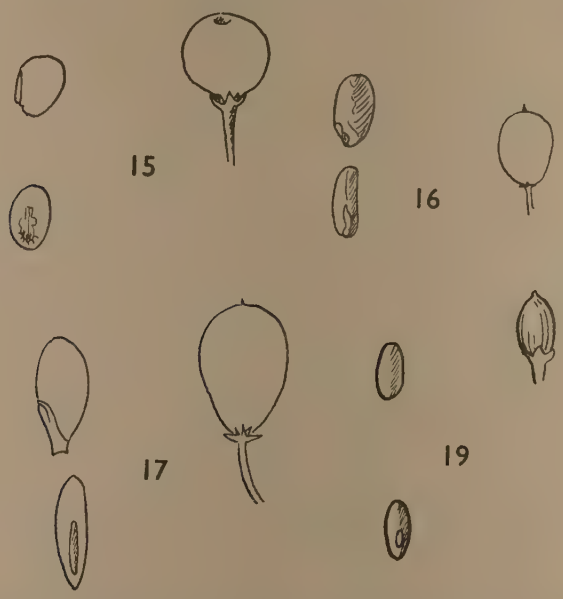


FIG. 15.—*Manilkara concolor*, seed and fruit (from *Gerstner* 3759, " Nangusi Forest ", Zululand, in NH).

FIG. 16.—*Manilkara mochisia*, seed and fruit (from *Wild* 2748, Ndanga, S. Rh., in SRGH).

FIG. 17.—*Manilkara macaulayae*, seed and fruit (from *Lovemore* 250, Sebungwe, S. Rh., in SRGH).

FIG. 19.—*Muriea discolor*, seed and fruit (from *Wood* 1349, Inanda. Natal, in NH).

and baboons for the flavour, 10–12 mm. long and 8–10 mm. in diameter, those I have seen 1–3 seeded. *Seed* brown, obovate-oblong or oblong, compressed, 8–11 mm. long, 5–7 mm. wide and 3–4 mm. thick, sub-produced at the base; testa brown, rather smooth, not very shiny, hard; scar basilateral, linear-elliptic or linear, 3–5 mm. long and 0·5–1·5 mm. wide, surrounded by a rather wide, pale brown, callus-like zone which includes the whole subproduced base of the seed.

A type specimen was originally not designated, as Baker, l.c., mentions two specimens, viz., a specimen from Batoka country, N. Rhodesia and one collected near Tete (Zambezia, P.E.A.), both leg. *Kirk*. As Engler only mentions the specimen from Tete in his monograph, I propose to make this one the lecto-type (in herb. Kew.)

Natal.—Umbombo: Otobotini, near Ndumo Game Reserve, *Gerstner* 3438 (NH).

Swaziland.—Probably near Stegi, *Pole Evans* 3488 (= 66).

Transvaal.—Nelspruit: Kruger National Park, Skukuza, *Codd & deWinter* 4992, *van der Schijff* 1262. Pretoriuskop, *v. d. Schijff* 2014; Mbeyamide, *v. d. Schijff* 2044, 1136. Pilgrims Rest: Kruger National Park, near Skukuza *Codd* 4388; Nwanetsi, *v. d. Schijff* 320. Letaba: Kruger National Park, near Shingwedsi, *Codd & Dyer* 4660; near Letaba, *Lamont* 33. Sebasa: Punda Maria *Codd* 4238, *Codd & Dyer* 4537, *v. d. Schijff* 568, 570; Nuanetsi, *Gerstner* 6061 (all PRE).

Portuguese E. Africa.—Sul do Save: Maputoland, Pto. Henrique, *Gerstner* 6670 (PRE); Lourenço Marques, *Borle* 144 (PRE); nr. Macia, *Pedro & Pedrogão* 1442 (PRE); nr. Chibuto, *Pedro & Pedrogão* 1535 (PRE); Guiza, *Pedrogão* 348 (PRE); nr. confluence of Limpopo and Nuanetzi Rivers (nr. Transvaal border); *Smuts* P. 332 (PRE); Maringua, Sabi Riv., *Chase* 2454 (SRGH). Zambesia: Tete, *Kirk* 304 (fragment of type in PRE, ex herb. Kew); id., Baroma, Sisitso Riv., *Chase* 2753 (SRGH); *Menyhart* 771 (Z, photo PRE!, holotype of *M. menyhartii* Engl.).

Southern Rhodesia.—Ndanga: *Wild* 2748 (SRGH); *Chase* 2367 (SRGH). Chipinga: Makosa Hills, *Phelps* 200 (PRE, SRGH). Melsetter: *Chase* 1767 (SRGH). West Nicholson: *Plowes* 1524 (PRE, SRGH).

Nyasaland.—Chiromo: *Hornby* 2902 (PRE).

Tanganyika.—Lindi: Lake Lutamba, *Schlieben* 5500 (PRE). In addition, the following material was kindly sent on loan from the E. African Herbarium, Nairobi, which I refer to this species:

Tanganyika Territory.—Moa-Mwakijembe: *Kermode* AH9930. Tabora: *Forest Guard Tabora* 1517.

Kenya.—Bura, Tana Riv.: *Bally* B2805. Kitui Distr., Nzui; *Edwards* E79. Coast, Kiunga: *Elliott* OX 888; N. Giriama: *Kale* K 3663. Kibwezi: *Gibbons* K2571.

Engler describes *Mimusops mochisia* in his monograph as having staminodes often bearing a long filamentous portion at the apex (Engler, op. cit., 1904, t. 22, Fig. B, d, and in the description, op. cit., 63: " staminodiis e parte basali subquadrati in appendicem filiformem filamenta aequantem saepe productis "). Baker (l.c.) does not mention

the filiform appendages, but describes " 6 minute toothed petaloid cuneate truncate glabrous staminodes ". Miss Kies, our officer stationed at Kew in 1950, examined one of the original specimens (leg. *Kirk* at Tete), and reported that this specimen does not possess the filamentous appendages (at least not in the flowers she dissected). Upon examination of a fragment of the specimen *Kirk* 304 from Tete, kindly sent through the courtesy of the Keeper of the Herbarium at Kew, I came to the same conclusion. In my opinion, the shape of the staminodes in this group of *Manilkara* (Section *Isogyne* of Engler, op. cit., 1904) is not a constant character. Both in *Manilkara concolor* and in *M. macaulayae* a great variation in the shape of the staminodes is found, from small and subsquamiform to long-subulate, or some having filamentous appendages (see Fig. 17), and in the few flowering specimens of *M. mochisia* I could examine, several different forms of staminodes were found: trilobed, spathulate, dentate, bifid, etc. Apart from the differences in the shape of the staminodes, the differences mentioned by Engler between *M. mochisia*, *M. densiflora* and *M. menyhartii* are negligible. The leaf-shape reported for *M. menyhartii* is frequently found on specimens also having some longer and narrower leaves. The three type specimens are evidently only forms of one rather variable species, and *Mimusops mochisia* Baker being the oldest name, the name *Manilkara mochisia* (Baker) Dubard applies to all three forms under discussion. A syntype, which I propose as the lecto-type, of *Mimusops densiflora* Engl. non Baker is still extant (in herb. Hamburg) and was compared by Mr. de Winter with specimens of *M. mochisia*. He reported that they are identical. An isotype of *M. menyhartii* in herb. Zürich also proved to be a good match.

Mimusops fischeri (Engl.) Engl., the type of which was destroyed during the last war and of which no isotypes could be traced, is most probably closely related to *M. mochisia*, but I hesitate to refer it to this species, because in the description of *M. fischeri*, the innovations are reported to be densely tomentose, whereas the older leaves are said to be glabrous. The young parts of *M. mochisia* are never densely tomentose in the specimens I have seen and on the other hand the older leaves of *M. macaulayae*, which species also comes into consideration, are very rarely quite glabrous, but may by an oversight have been described as glabrous in Engler's description. The old leaves are described as coriaceous which applies to *M. mochisia* rather than to *M. macaulayae*. The pedicels of the type specimen, which was in bud, were described as 3–6 mm. long, which points to *M. mochisia* rather than to *M. macaulayae*. Upon my request, Dr. B. Verdcourt of the East African Herbarium, Nairobi, sent me their material labelled *M. densiflora*. The specimens in question, including those from the type area of *M. fischeri*, proved to be *M. mochisia* and did not include specimens referable to *M. macaulayae*. For these reasons the identity of *Mimusops fischeri* Engl. remains somewhat uncertain, but the evidence is mostly in favour of *M. mochisia*, and I therefore regard *Mimusops fischeri* as a probable synonym of *M. mochisia*.

The history of the name of *Manilkara densiflora* is interesting from a nomenclatural point of view, although the name falls into synonomy. Engler and Baker published the binomial *Mimusops densiflora* almost simultaneously, but for different plants. Baker's name (in Kew Bull. 1895, p. 148) antedates Engler's [Pflanzenw. Ost-Afr., C. (1895), p. 307]. Strictly speaking, all combinations based on Engler's name are invalid, but of course the name *densiflora*, not being preoccupied in *Manilkara*, can still be used for this species. Brenan and Greenway, therefore, took up the combination made by Dale as a " new name ", *Manilkara densiflora* Dale. *Mimusops densiflora* Baker was reduced to *Mimusops multinervis* Baker by Engler in his Sapotaceae monograph, and

Mimusops densiflora Engler, as was pointed out above, becomes a synonym of *Manilkara mochisia*. *M. mochisia* is closely related to *M. concolor* and *M. macaulayae*, and resembles especially the latter very much in habit. There is no doubt that they represent three distinct species which can be distinguished as follows:

	M. concolor.	*M. mochisia.*	*M. macaulayae.*
Arrangement of leaves	Older leaves not strictly terminal, no short thick lateral shoots bearing leaves.	Older leaves strictly terminal, and on very short thick lateral shoots.	As in *M. mochisia.*
Pubescence....	Leaves quite glabrous..	Leaves quite glabrous	Leaves usually more or less pubescent; older ones rarely *quite* glabrous.
Seeds.....	Rather small, brown, smooth and shiny, not or hardly compressed, 9–11 mm. long, and 5–7 mm. thick (if one seed per fruit) or 3–5 mm. thick (more seeds per fruit).	Rather small, brown, rather smooth, not very shiny, much compressed, 9½–11 mm. long and 3–4 mm. thick.	Rather large, greyish-brown, not smooth, dull, much compressed, about 16 mm. long and 3½–4 mm. thick.
Scar.....	± 3 mm. wide, not surrounded by a callouslike zone.	½–1½ mm. wide, surrounded by a rather wide callus-like zone which includes the whole sub-produced base of the seed.	½–1 mm. wide, surrounded by a callus-like zone, which includes the whole produced base of the seed.

Although *M. mochisia* and *M. macaulayae* are distinct species, it is difficult to distinguish specimens of the latter with only glabrous old leaves from *M. mochisia*. In this case the additional characters used in the key, viz., the length of the pedicels and the pubescence of the calyx, can be used to distinguish them.

4. **M. macaulayae** (*Hutch. et Corb.*) *H. J. Lam* in Blumea 4: 356 (1941).

Mimusops macaulayae Hutch. et Corb. in Kew Bull. 1924: 329,330, fig. A (1924); type: *MacAulay* 1002 from Northern Rhodesia in K, holo; fragment in PRE. *M. spiculosa* Hutch. et Corb., op. cit., 330, 331, Fig. B., type: *Allen* 185 from Victoria Falls in K, holo; BOL! and PRE!, isos. *M. umbraculigera* Hutch. et Corb. l.c., and Fig. C (p. 330); type: *N.N.* from Southern Rhodesia in K, holo, = SRGH No. 2639, iso!. *?Mimusops fischeri* (Engl.) Engl., Mon. Sapot. Afr. 64 (1904).

Manilkara spiculosa (Hutch. et Corb.) H. J. Lam, l.c., and *M. umbraculigera* (Hutch. et Corb.) H. J. Lam, l.c.

A small to medium-sized deciduous tree up to about 15 m. high, with divaricate, subverticillate or zig-zag wise arranged, often crooked branches. *Branches* dimorphous: main shoots rather long (internodes usually 5–10 cm. long), lateral short branches usually ±5 – ± 15 mm. long, rarely longer; internodes of main shoots terete, rather smooth with faint longitudinal fissures, striations or wrinkles and (if not very young) glabrous and at least 3–6 mm. thick, and only the very young ones bearing a few leaves that are not strictly terminal; short shoots and apices of branches frequently thicker than the adjoining internodes, very rough with the close scars of fallen leaves; youngest shoots at first densely yellowish- or pale rusty-tomentose,

glabrescent. (New branches are formed under the terminal thickened portions of the branches and this causes the peculiar divaricate or subverticillate appearance, the original terminal portion becoming a short lateral branch). *Innovations*, young leaves (mainly below), pedicels and outside of calyx-lobes with a pale buff pubescence, the latter often, and on the leaves always, turning white. *Leaves* in rather dense, more or less fan-wise spreading groups on the short lateral branches and terminal apices (apparently both terminal and lateral thickened portions of the stems being able to produce young leaves in several seasons in succession); blade narrowly elliptic-obovate to narrowly spathulate-oblong or more or less cuneate-oblong, usually rather narrow, 3–5 (–7·5) cm. long and 1–2 (–3) cm. wide, with a usually distinctly emarginate or retuse, sometimes rounded apex, narrowing to the base, with minutely reflexed margins, rather firm but not coriaceous (*M. mochisia* has more coriaceous leaves as a rule), drying an opaque green or brown, slightly paler beneath, densely tomentose or pubescent when young, at least on the lower surface, very rarely becoming quite glabrous, but usually at least retaining vestiges of an adpressed whitish pubescence beneath, especially near the midrib and towards the base; midrib either slightly raised or slightly immersed, flush or minutely keeled and not very wide above, prominent beneath, usually discolorous in dried specimens; secondary nerves slender, often inconspicuous, rather numerous (± 10 to ± 15 on either side), parallel and straight, ascending at an angle of about 60°, faintly raised above, subimmersed below, usually bifurcate well inside the margin and their ramifications soon merging with the finer reticulate nervation; tertiary nerves not or hardly descernible from the very fine, tessellate, reticulate nervation which is always distinct in older leaves. *Petioles* flattened and canaliculate 3–7 (–10) mm. long, glabrescent but as a rule never becoming quite glabrous. *Flowers* often appearing with or just before the young leaves, solitary or in small fascicles in the axils of fallen leaves below the young growths; pedicels and calyx of a greenish-fawn or buff colour. *Pedicels* often more than 12 mm. long, rather slender and faintly angular, abruptly widening into the calyx. *Sepals* 3 + 3 or sometimes 4 + 4; those of the outer and inner rows subequal, ovate-elliptic (3–) 4 mm. long and (2-) 3 mm. wide, but the outer ones with a broad base, the inner ones slightly thinner in texture, with a narrower base and the greatest width just above the middle, all obtuse, tomentose outside, glabrous inside except near the apex. *Corolla* glabrous, probably yellow or yellowish; the tube less than 1 mm. long, the lobes and lateral appendages subequal, oblong-lanceolate, 3–4 long and ± 1 mm. wide, rounded or obtuse at the apex. *Staminodes* sometimes fewer than the number of calyx-lobes, usually much shorter than the filaments but sometimes nearly as long, glabrous, very variable in shape, varying (often in one specimen or even in one flower) from triangular, trilobed, tridentate or subquadrate to oblong, irregularly dentate or serrate to linear-subulate or subulate from a sub-quadrate or semi-orbicular basal portion. *Filaments* subulate or linear-terete, 1·5–2 mm. long; anthers ovate-oblong or ovate-lanceolate, 1·5–2·5 mm. long. *Ovary* 6- (or 8-)-loculated, ovoid-globose, more or less angular, 1¼–1¾ mm. long and 1–1¼ mm. in diameter, pubescent, more or less gradually tapering into the glabrous, long-subulate, angular to subterete and minutely truncate, 3–4 mm. style. *Fruiting* pedicels lengthening and up to 25 mm. long, slightly incrassate and ultimately about 1 mm. thick, glabrescent; calyx under fruit persistent. *Berry* ellipsoid or obovoid-oblong, with a narrow base, about 18 mm. long, 8–10 mm. in diameter, edible, the few seen all one-seeded. *Seed* obovate oblong, compressed, ± 16 mm. long, ± 7 mm. wide and 3½–4 mm. thick, narrowed and more or less unequal at the base, laterally produced at the side of the scar; testa a dull greyish brown, more or less rugose, or tuberculate, hard; scar linear, ± 8 mm. long and 0·5–1 mm. wide, surrounded by a light brown and rather shiny, slightly thickened zone which is about 12 mm. long and about 3 mm. wide and includes the whole produced base of the seed.

ANGOLA.—Caposolo: *Faulkner* (A) 64 (PRE).

BECHUANALAND.—Chobe: Serondela, *O. B. Miller* B/1128, B/1203, (PRE). Kachikau on road to Kasane, *Erens* 380 (PRE, SRGH). Small island in marches near Ghanzi, 22′ 30¹ E, 19° 5′ S: *Story* 4789 (PRE).

SOUTHERN RHODESIA.—" Matabeleland ": Mrs. *Pardy* s.n. (SRGH No. 5027). Urungwe: *Wild* 4163 (PRE, SRGH). Sebungwe: *Lovemore* 250 (SRGH). Hartley: Umswewe River, *Hodgson* H. 35/48 (SRGH); Gatooma, *Golding* s.n. (SRGH No. 31015, 31267); *Eyles* in QVM. Herb. No. 7264, 7507 (SRGH); Hartley: *Eyles* in QVM. Herb. No. 7507 (SRGH). Wankie: Wankie Camp, *Pole Evans* 2751 (PRE, SRGH); Victoria Falls, *Allen* 185 (isotype of *Mimusops spiculosa*. Hutch et Corb., (PRE, BOL); *Galpin* 7052 (PRE); *Wild* 3088, 3106 (SRGH). Bulawayo: *Hodgson* s.n. (PRE, SRGH). Without precise locality: *N.N.* in SRGH 2639 (isotype of *Mimusops umbraculigera* Hutch. et Corb.); specimen sent by *Dept. of Munitions*, S. Rh., to Bolus Herb (BOL. 25013).

NORTHERN RHODESIA.—Victoria Falls, N. bank, *Pole Evans* 2751 (8) (PRE, SRGH) Lusaka: Mumbura, *MacAulay* 1002 (fragment of type of *Mimusops macaulayae*, PRE).

A study of the few flowering specimens I have seen (including a fragment of the type specimen and, in addition, isotypes of *Mimusops spiculosa* and *M. umbraculigera*) showed that the staminodes are very variable in shape and length and that in a single flower triangular, serrate, bifid, dentate and subulate ones may occur (Fig. 18). In the isotype of *M. umbraculigera*, I found bifid and triangular staminodes apart from the irregularly dentate ones described in the species diagnosis by Hutchinson and Corbishley; in the isotype of *M. spiculosa* bifid ones occur apart from the subulate ones mentioned in the original species diagnosis. In *Faulkner* (A) 64 such a great variation is found (see Fig. 18), that I am convinced that the three species described by Hutchinson and Corbishley, are conspecific. Apart from the character of the staminodes, the differences they mentioned are very slight and as far as I have seen, not constant (such as the shape of the filament, relative lengths of filaments and anthers, pubescence) so that there is no reason to distinguish more than one species. As regards the possible identity with *Mimusops fischeri* Engl., see the discussion under *Manilkara mochisia*.

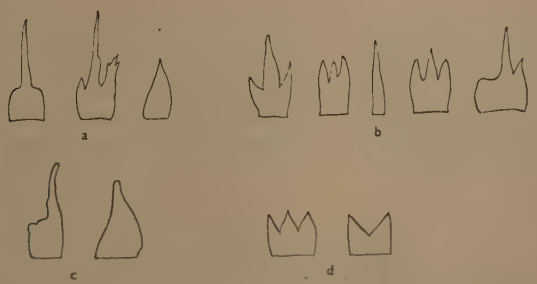


FIG. 18.—Shapes of staminodes in *Manilkara macaulayae*: (*a*) 3 staminodes found in one flower of *Faulkner* (A) 64 from Angola; (*b*)5 staminodes of another flower of the same specimen; (*c*) 2 staminodes from isotype of *Mimusops umbraculigera* (SRGH No. 2639 from Rhodesia); (*d*) 2 staminodes out of one flower of *O. B. Miller* B/1128 from Bechuanaland.

9. MURIEA

Hartog in J. Bot. 16: 145 (1878) (diagnosis on p. 72 sub. *Eichleria* Hartog); Dubard in Ann. Mus. Col. Marseille 23: 28 (1915); H. J. Lam in Blumea 4: 348 (1941) and Table 1 (p. 350). *Eichleria* Hartog in J. Bot. 16: 72 (1878), non *Eichleria* Progel in Mart., Fl. Bras. 12, 2: 518 (1877).

Labourdonnaisia Boj. ex parte, Benth. & Hook, Gen. Pl. 2: 659 (1876); Gerstner in J. S. Afr. Bot. 12: 40 (1946).

Mahea Pierre, Not. bot. Sapot. 8 (1890).

Mimusops L. sect. *Muriea* Hartog in J. Bot. 17: 358 (1879).

Mimusops L., subgenus *Ternaria* (A. DC) Engl., sect. *Euternaria* Engl., subsect. *Muriea* (Hartog) Engl. in Mon. Sapot. Afr. 55 (1904), and sect. *Mahea* (Pierre) Engl., op. cit., 65.

Mimusops L., ex parte, C. H. Wright in Dyer, Fl. Cap. 4, 1: 439 (1909), p. 439; Phillips in Genera S. Afr. Flow. Pl., ed. 2: 568 (1951).

Type species: *Labourdonnaisia discolor* Sond. in Linnaea 23: 73 (1850) = *Muriea discolor* (Sond.) Hartog.

Trees with exstipulate, parallel-nerved leaves. *Flowers* trimerous, axillary, solitary or in fascicles. *Sepals* 3 + 3; corolla with short tube and 6 lobes, these lobes either bearing two lateral appendages (in this case 12 fertile stamens, sub-biseriate: 6 epipetalous and 6 alternipetalous) or the lateral appendages reduced, sometimes 0 (in this case usually stamens more or less sterile and transformed into subulate staminodes). *Stamens* inserted in the throat of the corolla tube. *Ovary* 6-loculated, hairy; style long-cylindric-subulate; ovules with basal or basilateral attachment. *Berry* (always?) 1-seeded. *Seed* with basilateral, oblong or elliptic scar; testa rather thin and brittle; endosperm copious; cotyledons thin, foliaceous.

Number of species: At least one in the coastal regions of Southern East Africa, possibly one or two more in tropical East Africa (if not conspecific with the first) and, according to Hartog (1878) and others, another species in the West Indies.

The nomenclature of the type species *Muriea discolor* (Sond.) Hartog is rather complicated. Sonder described it as a *Labourdonnaisia* and it was included in this genus by Bentham and Hooker in Gen. Pl. 2: 659. Hartog (1887) pointed out that the petals in *Labourdonnaisia* are equal and placed in one whorl, their number varying from 12–17, with an equal number of stamens, whereas the species described by Sonder has 6 corolla lobes with each 2 lateral appendages. On account of this difference, among other things, Hartog decided that the plant belongs to a different genus, which he described as *Eichleria*. This name being illegitimate on account of *Eichleria* Progel, Hartog changed the name to *Muriea*. A year later, he regretted this decision and included his genus *Muriea* as a section in his large genus *Mimusops* which comprised practically all the Sapotaceae—Mimusopoideae. Engler (1904), whose conception of *Mimusops* agrees with that of Hartog, included *Muriea* as a subsection of his section *Euternaria* (the greater part of which is now generally recognised as belonging to the genus *Manilkara* Adans.)

Dubard in 1915 resuscitated *Muriea*, which genus he placed near his section *Mahea* of *Manilkara*, on account of the absence of staminodes.

Baehni in Candollea 7: 467 (1938), reduces *Muriea* to *Mimusops*, which is altogether incomprehensible to me, because Baehni, op. cit., 465–466 excludes all forms with 3-merous flowers from *Mimusops* (and includes most of them in *Manilkara*).

Mahea Pierre remained a more or less problematic genus for a long time. Engler (1904) reduced it to a section *Mahea* of a large genus *Mimusops*. Dubard (op. cit., 27) reduced *Mahea* to a section of *Manilkara*. Baehni (op. cit., 461) follows Dubard.

Gerstner in J. S. A. Bot. 12: 49 (1946), finally, resuscitated the name *Labourdonnaisia discolor* Sond. In a subsequent publication in J. S. Afr. Bot. 14: 173 (1948), Gerstner pointed out that the anthers and the corolla-segments of this plant are reduced when the flowers develop in dry weather, or if the tree is not growing on fertile soil. He distinguished four *formae*, a *forma perfecta* and three progressively more depauperate forms. The most depauperate form corresponds with *Mahea natalensis* Pierre, so that *Mahea* becomes a synonym of *Muriea**. Incidentally, a specimen of *Wood* 1134 (type number of *Mahea natalensis* Pierre) in BOL bears fruits and its fruits and seeds are identical with those of *Muriea discolor*.

The synonymy of the plant described as *Mahea natalensis* Pierre is also rather complicated. Engler, when he reduced *Mahea natalensis* to *Mimusops*, made the combination *Mimusops natalensis* (Pierre) Engl. (1904). However, Schinz had validly published as specific name *Mimusops natalensis* Schinz in Bull. Herb. Boiss. 4: 441 (1896) and Engler renamed this species *Mimusops schinzii* Engl. Under the present rules, *M. natalensis* (Pierre) Engl. is illegitimate, being antedated by *M. natalensis* Schinz. The first name becomes a synonym of *Labourdonnaisia discolor* Sond., the second of *Mimusops marginata* N.E. Br. [= *Austromimusops marginata* (N.E. Br.) A. Meeuse, quod vide, see p. 350].

My reasons for resuscitating *Muriea* Hartog, at least for the species *Labourdonnaisia discolor* Sond., are the following:

1. *Labourdonnaisia* was described as having 12–18 equal corolla-lobes (and not 6 lobes each with 2 lateral appendages) and 12–17 stamens, sometimes with a few staminodes, whereas *Muriea* has 6 corolla-lobes, each having, in perfect flowers, 2 lateral appendages, and always 12 stamens (or rarely 12 staminodes).

2. *Labourdonnaisia* is reported to have a large and basal seed scar, whereas *Muriea* has a basiventral, rather narrow seed scar. *Muriea* has its affinities clearly with *Manilkara*; it is, in fact, a *Manilkara* with normally 6 + 6 stamens instead of 6 stamens + 6 alternipetalous staminodes. Its habit is also very much that of a *Manilkara* (parallel substriate nervation of the leaves, etc.). However, the absence of alternipetalous staminodes distinguishes it clearly from *Manilkara*.

The synonymy of the only South African species, therefore, becomes as follows:—

M. discolor (*Sond.*) *Hartog* in J. Bot. 16: 145 (1878); Dubard in Ann. Mus. Col. Marseille 23: 28 (1915).

Labourdonnaisia discolor Sond. in Linnaea 23: 73 (1850); Gerstner in Jl. S. Afr. Bot. 12:49 (1946), and 14: 173 (1948); Syntypes: *Gueinzius* 128 and *Gueinzius* 547 from Durban, Natal, in herb. Sonder nunc S. *L. sericea* Benth. et Hook. f., Gen. Pl. 2: 660, (1876), nomen.

Eichleria discolor (Sond.) Hartog in J. Bot. 16: 72 (1878).

Mimusops discolor (Sond.) Hartog in J. Bot. 17: 358 (1879); Engl., Mon. Afr. Sapot. 55, t. 34, Fig. A (1904); C. H. Wright in Dyer, Fl. Cap. 4, 1: 440 (1906).

Mahea natalensis Pierre, Notes Bot. Sapot. 10 (1890); type: probably *Wood* 1134, holo in P?, also in BOL, GRA.

Mimusops natalensis (Pierre) Engl., Mon. Afr. Sapot. 65, t. 25, Fig. B (1904) non *Mimusops natalensis* Schinz (1896); C. H. Wright, l.c.

A medium-sized tree, 10–20 m. high with a stem diameter up to about 60 cm. with grey, longitudinally fissured bark; on young branches the bark is smoother and often full of leaf-scars. *Ultimate branches* rather stout (at least 1·5 mm. thick), terete.

* This reduction of the lateral appendages in one species could possibly occur in the related genus *Manilkara* and that is why, to my mind, the species of Gilly's subgenus *Manilkariopsis* (Trop. Woods 73: 9) should be re-examined in the light of Gerstner's observations on *Muriea*, i.e., in relation to prevailing ecological conditions at the time of flowering.

Innovations shortly puberulous-tomentose, the pubescence cinnamon-coloured; older parts except the lower surface of the leaf very soon glabrous. *Leaves* more or less distinctly crowded at the tips of the branches, rather uniform in shape, almost invariably obovate-oblong, sometimes oblong, or more or less spathulate- or lanceolate-oblong, narrowed but usually not distinctly cuneate at the base, with a rounded, obtuse, subacute or very shortly acuminate and usually recurved, almost invariably emarginate apex, green above (often drying brown or greyish-brown), densely adpressed-silvery pubescent beneath, except on the midrib, with slightly recurved margins, 3·5–7 (–10) cm. long, 1·5–3·5 (–4·5) cm. wide; midrib immersed and distinctly channelled above, very prominent beneath, at first finely rusty-pubescent, ultimately glabrous and of a different colour than the silvery lower surface of the leaf (yellowish brown or dark brown when dry); secondary nerves 10–15 or more on either side, straight, ascending at an angle of 70*e*–90*e*, archingly joining near the margin, immersed but rather conspicuous above, immersed and partly hidden by the silvery tomentum below; tertiary nerves parallel to the secondary ones, usually inconspicuous below, but appearing as a fine striation above; fine ultimate nervation reticulate, usually invisible below except in the oldest leaves, but distinct and impressed above and giving the upper surface of the leaf a minutely tessellate, dull appearance. *Petioles* terete, hardly thickened towards the base, narrowly canaliculate above, glabrous, 6–15 mm. long. *Flowers* in few-flowered fascicles (often about 3 together). *Perfect flowers*: pedicels 5–10 mm. long, rusty-pubescent; *flower-buds* rounded at the top, broadly obovoid, ± 5 mm. long and 3–4 mm. in diameter; *sepals* almost completely free; the three outer ones rather coriaceous, broadly ovate, narrowed towards the tip, but not acute, ± 5 mm. long and ± 4 mm. wide, rusty-pubescent outside, subciliate, glabrous inside except near the apex, the inner ones narrower, 5–5·5 mm. long and ± 3 mm. wide, yellowish, whitish adpressed-pubescent outside and near the apex inside; *corolla* white or yellowish; tube 1·5–2 mm. long, cylindric; the lobes long-spathulate with a long-tapering, narrow base and rounded top, the appendages broader, lanceolate-oblong or linear, acuminate, all segments 3–3·5 mm. long; *filaments* 2–2·5 mm. long, filiform and slender; anthers 1·5–2 mm. long, ovate-cordate, apiculate; *ovary* depressed-conical, ± 1 mm. high and ± 1 mm. in diameter, densely sericeous-pilose; style glabrous cylindric, 3–3·5 mm. long, rather gradually tapering into the flat, subcapitate and ± 6-lobed stigma. *Imperfect flowers* on short pedicels (sometimes under 5 mm. long), often considerably smaller (e.g., calyx and corolla lobes only 2 mm. long); *corolla lobes* with reduced lateral appendages, trifid, tridentate or entire; *anthers* very small or wanting or sometimes developed, *ovary* and *style* as above but sometimes ovary more subglobose and style only ± 2 mm. long. *Fruit* spherical, edible and red when ripe, according to Gerstner (1946), but when dried ellipsoid, 8–12 mm. long and 5–10 mm. wide, crowned by the peristent style. *Fruiting pedicels* not appreciably lengthened or incrassate; fruiting calyx adpressed to the fruit. *Seed* elliptic in outline, compressed, ± 8 mm. long, ± 5 mm. wide, and ± 3·5 mm. thick in the middle; scar basilateral, oval or elliptic, 3–4 mm. long, and 1–2 mm. wide in the widest place; testa pale fawn-coloured when dry, thin and brittle.

Distribution.—Natal, from Durban northwards, Zululand, Swaziland, P.E. Africa and extending into East Tropical Africa.

Natal.—Durban: *Thorns* s.n. (NH No. 40612, PRE); Durban, Albert Park, *Van der Byl* s.n. (HN No. 16245 and 16246 in NH, GRA); *Gerstner* 4703 (PRE), *Butcher* (= *Gerstner* 4712) (PRE, SRGH); *Gerstner* 6820 (NBG, PRE). Pinetown: Umzinyati, *Wood* 11440 (PRE, NU, J). Ndwedwe: Inanda, *Wood* 1134 [GRA, BOL, one of the numbers cited by Engler sub. *Mimusops natalensis* (Pierre) Engl.], 1349 (NH, BOL, SAM). Palmiet, *Wood* 8378 (NH, NU, PRE). Lower Tugela: Darnal, *Schmidt* 39, 40 (NH). Hlabisa: near Hlabisa, *Gerstner* 4117 (NH, PRE) 4527 (PRE); Emgangado, *Gerstner* 5077 (RE, BOL, NBG); Hluhluwe Game Reserve, *Ward* 2639

(NH, PRE), " Zululand "; *Gerstner* 2539 (BOL). Ubombo: Bangazi Lake, *Boocock* FD herb. No. 5720 (PRE, SAFD). Swaziland (?): Mangusi Forest (prob. near Hlatikulu) FD. Herb. No. 5314 (PRE, SAFD).

Portuguese East Africa.—Sul do Save: Maputo, *Sim* 20992 (NU, PRE); Lourenço Marques: *Oliveira* 74 (LM); Inhaca Island, Mrs. *Moss* (J. No. 27637, also PRE) between Chongoene and Chidinguel: *Pedro* 247 (PRE); Chibuto e Vila Gomez da Costa, *Pedro & Pedrogão* 1559 (PRE). " Zavala Distr.," Afr. Music Res. Libr. III (PRE); Inhambane, *Gomes e Sousa* 1657 (PRE, COI), 1949 (COI); Inhambane, Maxixe, *Amostra* 1 (LM). Manica e Sofala: Macuacua, *Simão* 1251 (PRE); Gazaland, *Earthy* 27 (PRE); Masiyeni, *Earthy* 169 (PRE). Niassa: Porto Amelia, *Barbosa* 1865 (LM), *Barbosa & Lemos* 2031 (PRE); entre Pundankas e Nanga, *Barbosa* 2190 (PRE).

Southern Rhodesia.—Umtali: *Chase* 4664, 4559, 5722, *Ball* 1 (PRE, SRGH).

As this species is most probably found in other parts of tropical East Africa, it is not unlikely that it was described from this area under a different name. It is quite likely that Engler's species *Mimusops buchananii* in Pflanzenw. O. Afr., C, 307 (1895) and in Mon. Sapot. Afr. 56, t. 19, Fig. B (1904) and *Mimusops altissima* Engl., op. cit. (1904), 55, are referable to this species. These two have 12 stamens and the descriptions (and Figure of *M. buchananii*) agree very well indeed. This would extend the range of *Muriea discolor* to Nyasaland and Tanganyika.

An Enumeration of the Maytenus Species of Southern Africa.

By

W. Marais.

The revision of the South African *Celastraceae* by Davison in Bothalia 2: 289–346 (1927), was, for many years, the latest work available in South Africa. Loesener's treatment of the family in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 87–197 (1942), did not become available until several years after the war. He transferred the unarmed African species of *Gymnosporia* to *Maytenus*, a genus which had, up to that time, been regarded as being restricted to tropical and subtropical America.

Exell in Bol. Soc. Brot., Sér. 2, 26: 222 (1952) regards *Gymnosporia*, as defined by Loesener, as too artificial to be maintained, and transfers several of the armed species to *Maytenus*. Brenan in Mem. N.Y. Bot. Gard. 8: 238 (1953) and Blakelock in his series of notes on African *Celastraceae* [the first in Kew Bull. 1956: 237 (1956)] also hold the view that the separation of the two genera on a basis of the presence or absence of spines and short shoots is unsatisfactory when the supposed difference of a two-loculed versus a three-loculed ovary breaks down.

Ding Hou in Ann. Miss. Bot. Gard. 42: 215–302 (1955) expresses the view that *Gymnosporia* and *Maytenus* are distinct, though very closely related, and provides a tabular key using a large number of characters. After a careful comparison, however, there seems to be no character or combination of characters constant enough to justify the retention of *Gymnosporia*.

The following key and enumeration is tentative, but it has become imperative to make the combinations under *Maytenus* and to try and clarify some of the specific-level problems.

See Taxon 3: 196 (1954) for the proposal to conserve the generic name *Maytenus* H.B.K.

My thanks are extended to the Directors of all the herbaria who kindly sent material on loan to Kew.

Flowers in axillary fascicles, common peduncle none or less than 2 mm. long; plants unarmed and without short shoots; internodes sometimes much abbreviated, but leaves never in true fascicles:

- Leaves with resinous threads on being broken ..... *M. acuminatus.*
- Leaves without resinous threads:
  - Leaves entire, suborbicular, obovate to obovate-elliptic ..... *M. lucidus.*
  - Leaves variously dentate, serrate or angled:
    - Capsules yellow, orange to orange-brown; leaves green or yellow-green; margin strongly revolute with 3–5 (rarely 6) teeth or angles on either side; apex rounded or obtuse ..... *M. procumbens.*
    - Capsules greenish or whitish, never brightly coloured; leaves green, grey-green or whitish on lower surface; margin flat or slightly revolute, obscurely angled to sharply and spinously dentate or serrate, usually with more than 6 teeth on either side; apex often acute or acuminate, but some rounded or obtuse ..... *M. undatus.*

Flowers in cymes; cymes axillary or appearing fascicled on short shoots; peduncle sometimes reduced, but then plants armed and with short shoots; leaves often fascicled:

Plants unarmed and without short shoots; leaves never fascicled:

Leaves with resinous threads on being broken..... *M. acuminatus.*

Leaves without resinous threads:

Plants, or at least the young parts pubescent..... *M. pedunculariS.*

Plants glabrous:

Leaf-margin closely serrulate; blade narrowly lanceolate; veins prominent on lower surface..... *M. bachmannii.*

Leaf-margin entire; blade broadly ovate to narrowly lanceolate, thick and leathery with veins more or less immersed..... *M. oleoides.*

Plants armed and with short shoots; leaves often fascicled:

Young parts puberulous or pubescent:

Leaves lanceolate, oblanceolate or narrowly elliptic, entire or scarcely dentate. Capsule papery. Flowers greenish-white to cream..... *M. tenuispinus.*

Leaves ovate to ovate-elliptic, closely serrate or crenate-serrate; capsule leathery to almost woody; flowers pink to red..... *M. mossambicensis* var. *ruber.*

Plants glabrous:

Ovary two-celled:

Leaves oblanceolate to obovate, finely and regularly serrate..... *M. senegalensis.*

Leaves linear to lanceolate or lanceolate-oblong, entire, repandly dentate or coarsely serrate..... *M. linearis.*

Ovary three-celled:

Leaves entire or nearly so; bark developing very early on young twigs which are brown or whitish, sometimes longitudinally wrinkled but not angular-striate (see also *M. cymosa*):

Leaves obovate-cuneate, thick, the veins usually completely immersed; capsule thick, woody..... *M. capitatus.*

Leaves oblanceolate or oblanceolate-oblong, often discolorous, the veins raised, at least on lower surface; capsule thin-leathery..... *M. polyacanthus.*

Leaves serrate, dentate or crenate-serrate, rarely almost entire, but then young twigs usually green and angular-striate:

Mature leaves thin, ovate or ovate-lanceolate, often rounded at the base or broadest below the middle; margin often sharply serrate; twigs slender, often reddish; inflorescence very lax, often few-flowered, with long, slender main branches *M. mossambicensis* var. *mossambicensis.*

Mature leaves leathery to very thick leathery, variable in shape, often cuneate and broadest above the middle, except for leaves on young growth, or else very thickly leathery if rounded at the base; margin crenate-serrate to subentire or entire; twigs brown, grey or green; inflorescence lax to very dense, with rather stout or short main branches:

Leaf margin revolute; blade more or less elliptic above the distinct petiole, almost invariably drying brownish, discolorous; spines absent or present, the whole or at least their tips often shiny dark-brown; twigs sometimes longitudinally wrinkled but often striate with definite raised lines *M. nemorosus.*

Leaf-margin usually flat; blade very variable in shape and texture, but not often as above; petiole sometimes distinct but when blade cuneate it is often decurrent on the petiole; usually drying green or grey-green, only rarely discolorous; spines absent or up to 20 cm. long, but never shiny dark-brown; twigs often strongly angled or striate.... *M. cymosus.*

1. **M. lucidus** (*L.*) *Loes.* in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 140 (1942).

Celastrus lucidus Linn., Mant. 49 (1767); Sond. in Harv. & Sond., Fl. Cap. 1: 456 (1860).
Gymnosporia lucida Loes. in Engl & Prantl, Nat. Pflanzenfam. 3, 5: 208 (1892); Davison in Bothalia 2: 294 (1927).

2. **M. procumbens** (*L.f.*) *Loes.* in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 140 (1942).

Celastrus procumbens Linn. fil., Suppl.: 153 (1781); Sond., l.c. 457.
Gymnosporia procumbens Loes. in Engl., Bot. Jahrb. 39: 169 (1906); Davison, l.c. 297.

3. **M. undatus** (*Thunb.*) *Blake* in Kew Bull. 1956: 237 (1956).

Celastrus undatus Thunb., Prodr. Pl. Cap.: 42 (1794); Sond., l.c.
C. ilicinus Burch., Trav. Int. S. Afr. 1: 340 (1822); DC., Prodr. 2: 7 (1825).
Catha fasciculata Tul. in Ann. Sci. Nat., Sér. 4, 8: 98 (1857).
Celastrus zeyheri Sond., l.c. 456.
Gymnosporia undata Szyszyl., Polypet. Discifl. Rehmann.: 34 (1888); Loes. in Engl. & Prantl, Nat. Pflanzenfam. 3, 5: 208 (1892); Davison, l.c. 296.
G. rehmannii Szyszyl., l.c.; Loes., l.c.
G. zeyheri Szyszyl., l.c. 33; Loes. in Engl., Bot. Jahrb. 17: 548 (1893); Davison, l.c. 294.
G. fasciculata Loes. in Engl. & Prantl, Nat. Pflanzenfam. 3, 5: 208 (1892); Davison, l.c. 298.
Celastrus albatus N.E. Br. in Kew Bull. 1906: 16 (1906).
Gymnosporia deflexa Sprague in Kew Bull. 1906: 246 (1906); Davison, l.c. 299.
G. albata Sim, For. & For. Fl. Col. Cape Good Hope: 186 (1907): Davison, l.c.
G. ilicina Loes. in Engl., Pflanzenw. Afr. 3, 2: 225 (1921); Davison, l.c. 296.
G. peglerae Davison, l.c. 298.
Maytenus ilicinus Loes. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 140 (1942).
M. fasciculatus Loes., l.c.
M. zeyheri Loes., l.c. 138.

4. **M. oleoides** (*Lam.*) *Loes.*, l.c. 137.

Celastrus laurinus Thunb., l.c. non *Maytenus laurinus* Briq. 1919.
C. oleoides Lam., Tabl. Encycl. & Meth. 2: 293, No. 2696 (1797).
Scytophyllum laurinum E. & Z., Enum. Pl. Afr. Austr.: 124, No. 966 (1834–5); Sond., l.c. 471.
Scytophyllum angustifolium Sond., l.c. 472.
Gymnosporia laurina Szyszyl., l.c. 35; Loes. in Engl. & Prantl, Nat. Pflanzenfam. 3, 5: 208 (1892); Bolus & Wolley-Dod in Trans. S. Afr. Phil. Soc. 14: 247 (1903); Davison, l.c. 310.
G. angustifolia Loes., l.c.; Bolus & Wolley-Dod, l.c.; Davison, l.c. 300.
G. monococca Davison, l.c.
Maytenus monococcus Loes. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 138 (1942).
M. angustifolius Loes., l.c.

5. **M. acuminatus** (*L.f.*) *Loes.*, l.c.

Celastrus acuminatus Linn. fil., l.c. 154 (1781); Sond., l.c. 454.
C. cordatus E. Mey. ex Sond., l.c.
Gymnosporia acuminata Szyszyl., l.c. 33; Loes. in Engl. & Prantl, Nat. Pflanzenfam. 3, 5: 208 (1892); Davison, l.c. 311.

C. cordata Sim, l.c. 184; Davison, l.c. 300.
Maytenus cordatus Loes. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 138 (1942).
Gymnosporia filiformis Davison in Bothalia 2: 311 (1927), may belong here. All the flowers examined showed a 5-celled ovary with more than 2 ovules in each cell. More material is required before this can be cleared up.

6. **M. peduncularis** (*Sond.*) *Loes.*, l.c. 136.

Celastrus peduncularis Sond., l.c.
Gymnosporia peduncularis Loes. in Engl. & Prantl, Nat. Pflanzenfam. 3, 5: 208 (1892); Davison, l.c. 308.

7. **M. bachmannii** (*Loes.*) *Marais*, comb. nov.

Gymnosporia bachmannii Loes. in Engl., Bot. Jahrb. 19: 232 (1894); Davison l.c.

8. **M. capitatus** (*E. Mey. ex Sond.*) *Marais*, comb. nov.

Celastrus capitatus E. Mey. ex Sond., l.c. 458.
Gymnosporia capitata Loes. in Engl. & Prantl, Nat. Pflanzenfam. 3, 5: 207 (1892); Davison, l.c. 293; Loes. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20 b: 150 (1942).

9. **M. polyacanthus** (*Sond.*) *Marais*, comb. nov.

Celastrus polyacanthus Sond., l.c. 455.
Gymnosporia polyacantha Szyszyl., l.c. 34; Loes. in Engl. & Prantl, Nat. Pflanzenfam. 3, 5: 207 (1892); Davison, l.c. 302; Loes in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 150 (1942).
G. vaccinifolia Conrath in Kew Bull. 1908: 211 (1908); Davison, l.c. 303.

10. **M. tenuispinus** (*Sond.*) *Marais*, comb. nov.

Celastrus tenuispinus Sond., l.c. 456.
Gymnosporia tenuispina Szyszyl., l.c. 33; Davison, l.c. 306; Loes., loc. cit.
G. botsabelensis Loes. in Bull. Herb. Boiss. 4: 429 (1896).

11. **M. linearis** (*L.f.*) *Marais*, comb. nov.

Celastrus linearis Linn. fil., l.c. 153; Sond., l.c. 455.
C. lanceolatus E. Mey. ex Sond., l.c. 456.
Gymnosporia linearis Loes. in Engl. & Prantl, Nat. Pflanzenfam. 3, 5: 207 (1892) Davison, l.c. 305; Loes. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 149 (1942).
G. lanceolata Loes. in Engl. & Prantl, Nat. Pflanzenfam. 3, 5: 207 (1892); Davison, l.c.; Loes in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 149 (1942).

12. **M. senegalensis** (*Lam.*) *Exell* in Bol. Soc. Brot., Sér. 2A, 26: 223 (1952).

Celastrus senegalensis Lam., Encycl. Meth. Bot. 1: 661 (1785).
Gymnosporia senegalensis Loes. in Engl. & Prantl, Nat. Pflanzenfam. 3, 5: 207 (1892); Davison, l.c. 320; Loes. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 147, 149 (1942).
G. dinteri Loes. in Bull. Herb. Boiss., Sér. 2, 3: 823 (1903).

13. **M. mossambicensis** (*Klotzsch*) *Blakelock* in Kew Bull. 1957: 37 (1957) var. **mossambicensis.**

Celastrus mossambicensis Klotzsch in Peter's Reise Mossamb. Bot. 112 (1861).
Gymnosporia mossambicensis Loes. in Engl., Bot. Jahrb. 17: 547 (1893); in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 152 (1942).
Celastrus concinnus N.E. Br. Kew Bull. 1906: 16 (1906).

var. **ruber** (*Harv.*) *Blakelock*, l.c.

Celastrus ruber Harv. in Harv. & Sond., Fl. Cap. 2: 592 (1862).
Gymnosporia rubra Loes., l.c.; Davison, l.c. 309; Loes. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 150 (1942).

14. **M. nemorosus** (*E. & Z.*) *Marais*, comb. nov.

Celastrus nemorosus E. & Z., l.c. 129, No. 938; Sond., l.c. 460.
Gymnosporia nemorosa Szyszyl., tom. cit.: 35; Davison, tom. cit.: 316.

15. **M. cymosus** (*Soland.*) *Exell*, l.c. 222.

Celastrus buxifolius Linn., Sp. Pl.: 197 (1753) pro parte, excl. Tab. Plukenet; Sond., l.c. 459; non *Maytenus buxifolius* Griseb.
C. ellipticus Thunb. in Hoffm., Phytogr. Blaett. 1: 22 (1803); Thunb., Fl. Cap. 119 (1818); Sond., l.c. 458; non *Maytenus ellipticus* Krug. & Urb. ex Duss. (1897).
C. cymosus Soland. in Sims, Bot. Mag. t. 2070 (1819).
C. heterophyllus E. & Z., l.c. 120, No. 943 ; Sond. l.c.
C. angularis Sond., l.c. 460.
Gymnosporia buxifolia Szyszyl., l.c. 34; Loes. in Engl. & Prantl, Nat. Pflanzenfam. 3, 5: 207 (1892); Davison, tom. cit.: 317; Loes. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 152 (1942).
G. woodii Szyszyl., l.c. 35; Loes., l.c.
G. heterophylla Loes. in Engl. & Prantl, Nat. Pflanzenfam. 3,5: 207 (1892); Davison, l.c.; Loes. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 152 (1942).
G. condensata Sprague in Kew Bull. 1906: 246 (1906); Davison l.c. 305.
G. angularis Sim, l.c. 186; Davison, l.c. 314.
G. elliptica Schonl. in Bot. Surv. Mém. S. Afr. 1: 73 (1919); Davison, l.c. 306.
G. angularis var. *orbiculata* Davison, l.c. 316.
G. angularis var. *grandifolia* Davison, l.c.
G. crataegiflora Davison, l.c. 314; Loes., l.c. in syn.
G. uniflora Davison, l.c. 294.

Solander, in his manuscript in the library of the British Museum of Natural History, gives the following reference: " H.S. 261. 34. Habitat ad Prom. b. spei (Desmaretz.)" Vol. 261 in the Sloane Herbarium contains plants collected by Desmarest at the Cape. The specimen on p. 34 must be the type of *Celastrus cymosus* Soland., and not the specimen figured on Bot. Mag. t. 2070. I can trace no specimen of the figured plant, which seems to be nearer to the form described as " *Gymnosporia angularis* ".

It has not been possible to ascertain the identity of all the species described from South African plants. Those not identified are as follows:—

G. eremoecusa Loes. in Engl., Bot. Jahrb. 41: 299 (1908).

The type of this has been destroyed. Judging from the description I have no doubt that it is the same as *M. senegalensis* (Lam.) Exell.

G. crenulata Engl., Bot. Jahrb. 10: 38 (1888).

Type destroyed. I have examined several sheets that have been called by this name, but they all belong to either *M. cymosus* (Soland.) Exell or *M. senegalensis* (Lam.) Exell.

G. acanthophora Loes. in Engl., Bot. Jahrb. 41: 299 (1908).

The type has been destroyed. All material that I have seen under this name belongs to *M. cymosus* (Soland.) Exell.

Maytenus rudatisii (Loes.) Loes. in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 20b: 138 (1942). *G. rudatisii* Loes. in Engl., Bot. Jahrb. 41: 307 (1908).

I have not been able to locate the type specimen; it has probably been destroyed. From the description it seems to be related to *Cassine eucleaeformis* (Sond.) O. Ktze.

G. schlechteri Loes. in Bull. Herb. Boiss. 2: 193 (1894).

Schlechter 241 differs from *M. cymosus* (Soland). Exell in the very lax and slender inflorescences, and its leaves are somewhat narrower than those of other specimens from the Cape Peninsula. It seems remarkable that no other material like it is available from such a well-collected area, and I am inclined to regard it as just another local form of the extremely variable *M. cymosus* (Soland.) Exell.

G. integrifolia (L.f.) Glover in Ann. S. Afr. Mus. 9: 206 (1915).

I have not yet been able to examine any authentic material. All the specimens quoted by Davison were misidentified; most of them belong either to *Maytenus cymosus* (Soland.) Exell or to *Putterlickia pyracantha* (L.) Endl.

G. saxatilis (Burch.) Davison in Bothalia 2: 303 (1927). *Celastrus saxatilis* Burch., Trav. Int. S. Afr. 2: 264 (1824).

Burchell cites only his No. 1671, which has 6 ovules per locule and therefore belongs to *Putterlickia*. In making the new combination, Davison added 3 more Burchell specimens. One of these is a sterile scrap, and both the others are, like the type, *Putterlickia pyracantha* (L.) Endl.

A New Genus of Gramineae.

By

B. de Winter.

Diandrochloa *de Winter*, genus nov. (Eragrosteae), affinis *Eragrosti ciliari* (L.) R. Br. et al., sed ita differt, ligula membranacea, palearum carinae leves vel scabrae, flores staminibus binis.

Spikelets laterally compressed, awnless, 2–14-flowered solitary, pedicelled, laterally placed in relation to the rhachis, not exceeding 3·5 mm. in length; rhachilla disarticulating between the florets and above the glumes, glabrous or scabrid, not produced beyond the uppermost floret. *Florets* hermaphrodite, falling entire with a segment of the rhachilla attached; callus very short, rather swollen, truncate, glabrous. *Glumes* persistent, unequal to subequal, membranous, often sub-hyaline, ovate to lanceolate, keeled, apex rounded or acute, one-nerved, nerve prominent and often green. *Lemmas* 0·5–1·5 mm. long, strongly keeled, often depressed between the keels, usually translucent or thinly coriaceous, pallid, greenish or flushed with purple, rounded, emarginate or acute or sometimes somewhat erose, lanceolate to broadly ovate-oblong when flattened, 3-nerved; nerves distinctly raised, very often dark green, glabrous or scabrid, midnerve percurrent, lateral nerves evanescent. *Palea* subequal to the lemma, membranous, broadly-oblong when flattened, 2-keeled nerves strongly developed in the lower part of the keels, evanescent upwards, smooth or scabrid, apex truncate or rounded or 3-lobed. *Lodicules* 2, truncate, tapering downwards. *Stamens* 2, anthers broadly oblong to rotund, 0·2–0·4 mm. long, anther thecae slightly divergent, attached more or less centrally. *Ovary* glabrous, styles terminal, free, stigma plumose. *Caryopsis* obovate-oblong to broadly spindle-shaped, brown, smooth and semitransparent when mature; hilum basal, punctiform; embryo $\frac{1}{4}$ to nearly $\frac{1}{2}$ the length of the grain, disc shaped, elliptic-oblong; starch grains simple.

Hygrophyllous caespitose annuals or perennials, culms rather soft, hollow, pallid, greenish or purplish, geniculate or erect, few to many- noded, branched or simple; basal sheaths rather loose, pallid-green or pinkish; leafblades linear, flat, occasionally flaccid, tapering to a setaceous point; panicles usually rigid, always much longer than broad, contracted and dense or much branched and divaricate, branches in pseudo-whorls on the strongly developed central axis.

Type species: *Diandrochloa namaquensis* (Nees) de Winter. Species about 7. Natives of the Americas, Australia, Asia and Africa.

It is surprising that this genus has not before been recognised as distinct. Possibly this is because it is represented in most countries by only one or two species. It was not even placed in a distinct section of its own within the genus *Eragrostis* but was always associated with species such as *E. tenella* and *E. ciliaris* which it resembles superficially. *E. tenella* and related species have ciliate ligules and the keels of the palea are fimbriate. These species should not therefore be confused with any of the species of *Diandrochloa.*

According to Dr. J. M. J. de Wet of the Division of Botany the chromosomes of *E. namaquensis* are smaller than those of the other species of *Eragrostis* which he has investigated. The basic number of 10 with the genome of 40 chromosomes is typical of Eragrostis and its allies.

The following species of Eragrostis should be transferred to the genus *Diandrochloa*: E. *glomerata* (Watt) Dewey (S. & N. America); *E. confertiflora* Black (Australia); *E. japonica* (Thunb.) Trin. (Asia); *E. diarrhena* Steud. (India); *E. diplachnoides* Steud. (Africa and Asia). The synonymy of most of the species listed above is very complicated and in some the status of the taxa is uncertain. For this reason I have refrained from making the combinations for species outside South Africa.

There are only two South African representatives of the genus *Diandrochloa* namely:—

(*a*) **Diandrochloa namaquensis** (Nees) de Winter, comb. nov. (*Eragrostis namaquensis* Nees).

(*b*) **D. pusilla** (Hack.) de Winter, comb. nov. (*Eragrostis pusilla* Hack.)

They can be distinguished as follows:—

Spikelets 1–1·5 mm. long, 2–4-flowered; lemmas ·5– ·6 mm. long; inflorescence branches with spikelets patently spreading when fully developed.... *D. pusilla.*

Spikelets 2–3 mm. long, 4–8-flowered; lemmas about 1.0 mm.; inflorescence branches somewhat contracted..... *D. namaquensis.*

1. **D. namaquensis** (Nees) de Winter

Eragrostis namaquensis Nees in Linnaea 12, 542 (1838) and Fl. Afr. Austr. 1.408 (1841); Chiov in Ann. Inst. Bot. Roma 8, 63 (1903), do. l.c. 363 (1908); do. in Nuovo Giorn Bot. Ital. n.s. 19, 423 (1912); de Winter in Grasses and Pastures S. Afr. 182 (1955). *E. namaquensis* var. *robusta* Stapf. in Fl. Cap. 7, 630 (1900). *Catabrosa micrantha* Hochst. ex A. Rich. Tent. Fl. Abyss. 2, 426 (1851) in synonymy.

Annual or *subperennial*, caespitose, culms erect 15–130 cm. high, hollow, rather soft, glabrous, pallid or greenish, finely striate, 1–6-noded, simple or branched upwards, upper internode exceeding the others and usually long exserted; sheaths striate, lax and slipping from the culms, pallid or flushed with purple, especially towards the base; leafblades linear and tapering to a fine point, flat or somewhat rolled, 5–25 cm. long; up to 5 mm. broad, nerves fine, slightly raised, scabrid; ligule membranous, about 0·5 mm. long. Panicle tightly contracted and linear or open and lax, 10–60 cm. long, erect, branches solitary or approximate and in pseudowhorls, erect and appressed or obliquely spreading, repeatedly divided from the base, subdivisions subcapillary, glabrous or scabrid. *Spikelets* pedicelled, more or less crowded on the branchlets, elliptic to oblong-elliptic, obtuse, 2–3 mm. long, 4–8-flowered, purplish or greenish-brown, rhachilla disarticulating above the glumes and between the florets, smooth, glabrous. *Florets* falling entire, hermaphodite; callus glabrous, slightly obliquely truncate. *Glumes* unequal to subequal, broadly oblong, obtuse and emarginate, about 0·75 mm. long, 1-nerved, persistent. *Lemmas* broadly ovate-oblong when flattened, obtuse, emarginate, about 1·0 mm. long, strongly keeled, 3-nerved, slightly depressed between the nerves, nerves smooth. *Palea* subequal to the lemma, falling with the lemma, keels smooth. *Lodicules* truncate, cuneate, very small. *Stamens* 2, anthers 0·3–0·4 mm. long, purple, broadly oblong. *Ovary* glabrous, styles free, stigmas plumose. *Grain* obovate-oblong; hilum basal, punctiform; embryo 2/5 of the length of the grain, rotund.

Very widely distributed in Africa, West Tropical Africa, British East Africa and South Tropical Africa. Also found in all the provinces of South Africa including S. West Africa.

This grass prefers moist localities and inhabits river banks and pools. Usually an annual, it is apparently sometimes a weak perennial. It varies tremendously in size, and can be from 15 cm. to over 130 cm. high. The shape of the inflorescence is also variable.

Holotype: Namaqualand, banks of Orange River, *Drege* 2569 (B; PRE, fragment).

Cape Province.—Port St. Johns: Umzimvubu River, *Sidey* 567; Mt. Frere: *Acocks* 13565; Mafeking: *Brueckner* 367; Hay: Langebergen, *Acocks* 8531; fountain at Rietkloof, *Acocks* 8534.

Natal.—Vryheid: White Umfolosi, *Curson* 148; mountain top, sides of stream, Hlobane, *Johnstone* 423; Hlabisa: Hluhluwe, river banks, *Ward* 2581.

Transvaal.—Potchefstroom: Vaal River, Nooitgedacht, *Louw* 1702; Pretoria: Petronella, *Acocks* 11713; 19 m. N.E. of Premier Mine, *Codd* 2764; Rustenburg: Elandskraal, *de Winter* 232 B; Ermelo: Morgenson, *Rose Innes* s.n.; Nylstroom: Warmbad, *Schweickerdt* 1786; Potgietersrust: Mosdene, *Galpin* M. 539; Barberton: *Bolus* 9794; Kruger National Park: Numbi, *v. d. Schyff* 2657; Shangani, *v. d. Schyff*, 2820; Punda Maria, *Codd* 5363; Soutpansberg: Tshokoma, *Obermeyer* s.n. Tvl. Mus. No. 31657.

Swaziland.—Mbabane: Mbeluzi Falls, near stream, *Compton* 25086.

Bechuanaland.—Makarikari Basin: Nata River, *Van Son*, Tvl. Mus. No. 28614.

South West Africa.—Tsoachaubsand Salem, *Dinter* 140; Otjiwarongo: Waterberg, *Vlok* 2240; Stream near Great Waterberg, *Rodin* 2568; Kaokoveld: banks of Kunene, *Story* 5859.

Angola.—*Boss* s.n., Tvl. Mus. No. 36763.

Southern Rhodesia.—Odzani Valley, *Eyles* 1685; Zambesi River, *Hitchcock* 24190, 24345; Cleveland Dam, *Gilliland* 46; Sabi-Lundi Junction, *Wild* 3339.

Northern Rhodesia.—Matonchi Farm, *Milne Redhead* 2758; Kashitu, *Stohr* 2845, 2844, 2834; River Mekeba, *Milne Redhead* 759; between Livingstone and Kaloma. *Pole Evans* 2797 (4); Broken Hill, *Rogers* 26093.

Portuguese East Africa.—Tumbini slopes, *Hornby* 3372.

Nyasaland.—Mlanje, Palombe Plain, *Laurence* 376; Benga, Lake Nyasa, *Brass* 17497; Mperere Mission, Chankalamu Dambo, *Jackson* 242.

Tanganyika.—Ardai Plain, *Greenway* 7014; Ngudu, Mwanza, *Lewys Lloyd* 16; Lindi, Mikindani, *Schlieben* 6555.

Belgian Congo.—Elizabethville, *Rogers* 26271; *Quarre* 4570, 5530.

Abyssinia.—Scholoda Mnt., *Schimper* 406 (fragment).

2. **D. pusilla** (Hack.) de Winter.

Eragrostis pusilla Hack. in Bull, Herb. Boiss. 4, app. 3, 27 (1896); de Winter in *Grasses and Pastures of South Africa*, 184 (1955).

Caespitose annual up to 30 cm. high, culms erect or slightly geniculate, 1–3 (usually 1)-noded, soft and compressible, pallid, finely striate, simple or branched; sheaths chartaceous, rather loose, pallid, greenish or brown, margins membranous; ligule a membranous rim; leafblades linear, thin, flat, tapering to a fine setaceous point, 4–13 cm. long and up to 0·5 mm. broad, primary nerves 5–7, nerves glabrous or scabrid. *Panicle* densely and divaricately branched, 8–15 cm. long, narrowly elliptic to narrowly oblong in outline, central axis strongly developed and rigid, branches clustered together in pseudowhorls especially lower down or solitary upwards, spreading obliquely or nearly at right angles, repeatedly and finely branched from the base upwards, divisions glabrous or sparsely scabrid. *Spikelets* awnless, more or less broadly oblong 1–1·5 mm. in length, 2–4-flowered, brownish to purplish, pedicelled, pedicels 0·5–1·5 mm.

long; rhachilla disarticulating above the glumes and between the florets, glabrous. *Florets* hermaphrodite, falling with an internode of the rhachilla attached, callus truncate. *Glumes* unequal, lower narrower and shorter than the upper, oblong, one-nerved, obtuse or slightly emarginate, persistent. *Lemmas* broadly oblong, obtuse, emarginate, 0·5–0·6 mm. long, 3-nerved, keeled, depressed between the nerves and membranous, nerves smooth, strongly raised. *Palea* subequal to and falling with the lemma, strongly keeled, keels smooth. *Lodicules* truncate, oblong-cuneate. *Stamens* 2, anthers 0.3–0·4 mm. long, broadly oblong. *Ovary* glabrous, styles free, stigmas plumose. *Caryopsis* obovate-oblong, hilum basal, punctiform, embryo more or less 2/5 the length of the grain.

This is a small delicate and rather decorative hygrophyte, inhabiting the margins of seasonal pools in the subtropical drier areas of the Transvaal, Cape, South West Africa and Bechuanaland and probably also occurring in S. Rhodesia and Angola.

Holotype: Kalahari: in stagnis exsiccatis prope Uugua, May, 1891, *Fleck* 321, (Herb. Hackel, Vienna; fragment in PRE).

Cape Province.—Kimberley: Riet Pan, near Riverton, *Reinhardt* 3228; Vryburg: farm Welgelegen, *Pentz* s.n., N.H. No. 14876.

Transvaal.—Bloemhof: *Louw* 1823; Soutpansberg: Farm Hamilton, *de Winter & Codd* 313.

South West Africa.—Maltahohe: Farm Urusis, *Kinges* 2548; Gibeon: Fish River Gorge, *V. Trotha* s.n.; Rehoboth: Kalkrand, *de Winter* 3521; Karibib: Farm Otiimbojo East, *Kinges* 3392; Okahandja: Waterberg, *Bradfield* 270; *de Winter* 2807; Okahandja River, *Dinter* 117; Grootfontein: Nosib, *Schoenfelder* S. 878; Nosib road, *Dinter* 7433; Tsumeb, *Dinter* 7432. Okavango: Omuramba Omatako, *Seiner* 685.

Most of the specimens named *E. namaquensis* Nees var. *uninodis* Hack. are in fact *E. pusilla*. I have not been able to trace a valid publication of the var. *uninodis*.

The Opening of the Pretoria National Botanic Garden.

By

R. A. Dyer.

After my return in 1934 from the Royal Botanic Gardens, Kew, I cherished the idea of a botanic garden attached to the National Herbarium, Pretoria. Kirstenbosch served the needs of the winter rainfall region of the Union, and a similar institution to serve the summer rainfall area was an obvious necessity. That it should be complementary to the National Herbarium also seemed obvious.

In 1944, towards the end of the war, the idea was given its first airing, in connection with the training of student gardeners, but the time was not propitious. In 1945 the botanical survey section of the Division of Botany was resuscitated with Dr. L. E. Codd in charge. The question of a new botanic garden was then brought into the open and the environs of Pretoria were explored for a suitable area.

At this juncture contact was made with Professor H. B. Davel, then director of the Agricultural Research Institute of the University of Pretoria. Together we inspected the piece of the University farm cut off from the main block by the Silverton and Brummeria roads, which had been found unsuitable for farm experimental purposes owing to its isolation and to the presence of an abundance of *gifblaar, Dichapetalum cymosum.* Other areas were considered including a portion of Rietondale Experimental Station, but the University ground was favoured above all others and this project gained the support of the then Minister of Agriculture Mr. J. G. N. Strauss.

The University Council gave formal approval of the development of the area as a botanic garden in June, 1946. Soon afterwards Mr. Jan Erens, head gardener at the Division of Botany, drew up a rough plan of the area, planted the first avenue of experimental trees, supervised the sinking of boreholes and saw to the building of 2 small reservoirs.

The decision in 1947 to purchase the western corner of portion F of Koedoespoort farm 299 proved abortive, owing to a ridiculously high price being placed on the property by the owner.

Mr. Erens was promoted into the Public Works Dept. in 1949 and Mr. A. van der Ende later took over his duties at the Division of Botany at Vredehuis, while Mr. J. Admiraal was appointed to the gardening staff and placed in charge of the new botanic garden.

In 1951 the University Council donated 200 acres on the opposite (south) side of the Brummeria road to the C.S.I.R. for its head office and laboratories. The Division hoped to be treated in similar fashion, but the University Council decided to retain the botanic garden ground under the Agricultural Research Institute.

In 1954, the Bureau of Standards negotiated with the University for the purchase of the botanic garden ground, and interested parties suggested that an area in the Fountains Valley or the Wonderboom Reserve would serve equally well as a botanic

garden. A Commission consisting of Professors W. J. Lutjeharms, A. W. Bayer, R. S. Adamson and N. P. Badenhuizen, reported strongly in favour of the existing project and their recommendation was accepted by the Minister of Agriculture at the time, Mr. S. P. le Roux and the University Council.

The building of a residence on the botanic garden for the gardener in charge was sanctioned in 1955, and was soon completed under the guidance of the P.W.D.

With the support of the Minister, Mr. le Roux, the Secretary for Agriculture, Dr. C. H. Neveling and the Director of Technical Services Dr. M. S. du Toit, we succeeded, in a matter of 13 days, in obtaining Treasury authority to purchase, on 15/10/55, portion G of farm Koedoespoort No. 299, nearly 8 morgen in extent, with northern aspect, to add to the botanic garden.

Progress has been most encouraging and the present Minister of Agriculture (Technical Services) Mr. P. K. le Roux, accompanied by Mrs. le Roux, opened the garden officially on 23rd October, 1958.

By the greatest good fortune, considering the unsettled weather at the time, the morning of the 23rd was perfect for the outdoor ceremony. A Cabinet Meeting called for 11 a.m. on the 23rd, threatened to wreck the opening ceremony, but all obstacles faded away at the last moment.

Mr. le Roux addressed the gathering of about 150 guests, speaking for the first half in Afrikaans and then in English. The text of his address, with a translation, was as follows:—

„ Die grond waarop ons vanmore staan is 'n deel van die Pretoria Universiteitsplaas—'n deel van die plaas wat vir die Fakulteit van Landbou opsygesit is. Effens oor die tien jaar gelede het die Universiteitsraad toegestem dat 'n botaniese tuin op hierdie terrein tot stand gebring kon word. Plantkunde, soos u sal begryp, is een van die basiese kursusse in die eerstejaars studiekursus van alle studente wat Landbou loop, dus is daar alle rede om noue samewerking tussen die Fakulteit en die Afdeling Plantkande te hê.

Dit doen my groot genoeë om op hierdie geskiedkundige geleentheid, naamlik die opening van hierdie botaniese tuin, die Rektor—Prof. Rautenbach—en die Universiteitsraad vir hulle vêrsiende beleid om hierdie ontwikkeling aan te moedig, te bedank. Die grond is ongeveer 68 morg groot. Deur slegs rond te kyk sal u besef wat 'n uitstekende ligging dit as botaniese tuin het. Dit is maklik bereikbaar daar dit op die nasionale pad van Pretoria na die Oostelike Transvaal en die Kruger Wildtuin geleë is. Al hoe meer oorsese besoekers sal langs hierdie roete reis en hierdie vertoonvenster van ons Suid-Afrikaanse flora sien. Dit sal gedurig in die oog van die publiek wees.

Daar is noordelike en suidelike hange; daar is 'n groot golwende gebied wat uit diep sanderige grond bestaan, en daar is hierdie mooi koppie agter my wat die hele terrein oorheers en vanwaar 'n groot deel van Pretoria sigbaar is. 'n Mens kan ook na die imposante reeks geboue wat deur die Wetenskaplike en Nywerheids Navorsingsraad oorkant die pad opgerig is, tuur, en peins omtrent wat alles in hulle gedoen word. Ja, hierdie is waarlik 'n stimulerende omgewing en ons kan verwag dat hierdie tuin in die jare wat voorlê iets om op trots te wees sal word.

Plantkunde in die breë sin van die woord ken geen grens tussen sulke onderwerpe soos Tuinbou, Plantsiektekunde, Weidingsnavorsing, Veldbeheer, Plantfisiologie en Planteteelt nie. Plantkunde dien hulle almal. Wanneer 'n nuwe gebied ontgin word is een van ons eerste pligte om 'n opname van die inheemse plantegroei te maak. Die samestelling van die natuurlike onbeskadigde veld toon beste aan hoe die land gebruik moet word om die maksimum landboukundige opbrengs daaruit te verkry.

My vriende wat boer is sterk bewus van die aanhoudende pogings van die Departement om die land meer bekwaam te gebruik. Hulle is bewus van die verslag oor hierdie onderwerp wat deur die Afdeling Ekonomie en Markte uitgegee is. Veldwerkers van die Afdeling Plantkunde het 'n belangrike bydrae tot hierdie werk gelewer deur veldtipes en hulle verspreiding af te baken.

Die boer self moet sy veld ken. Hy moet soveel as moontlik van die afsonderlike plante, wat sy veld vorm ken. Hy moet die goeie voerplante, wat aangemoedig en teen oorbeweiding beskerm moet word, ken. Hy moet ook die giftige plante, wat gedurig 'n bedreiging vir sy vee is, ken. Die Afdeling Plantkunde het baie inligting omtrent hierdie onderwerpe versamel, maar sal in hierdie ontsaglik studieveld nooit alles kan weet nie. Ons kennis is nooit volledig nie. Plante uit die veld sal in hierdie tuin vir verdere studie gekweek word en die inligting aldus verkry sal soos in die verlede, vir die boeregemeenskap en algemene publiek, beide in die Unie en oorsee, beskikbaar gestel word.

Die geskeidenis van Landbou in die Unie gaan terug na die aankoms van Jan van Riebeeck aan die Kaap in 1652. Een van sy eerste pligte was om 'n tuin vir die kweek van groente, om handelsskepe van die Hollands-Oos-Indiese Kompanjie daarmee te voorsien, tot stand te bring. Die geskiedenis van die Landbou in Transvaal dek egter 'n baie korter tydperk en begin kort voor 1900. Sommige van die vroeë gebeurtenisse is van algemene belang en toepaslik op hierdie geleentheid. In 1896 het die Volksraad 'n veearts, Arnold Theiler, aangestel om die Runderpes, wat toe gewoed het, te bestry. 'n Plantkundige, Burtt Davy, is in 1903 aangestel, dus het die Departement van Landbou in die Transvaal met die aanstelling van 'n veearts en 'n plantkundige begin. Die plig van die plantkundige was om in die veld uit te gaan, boere te ontmoet, en die landboubehoeftes van die verskillende streke te bespreek, om die voerplante van die natuurlike veld te bestudeer, sowel as die giftige plante, skadelike onkruid, ens. Daarby moes hy verteenwoordigende versameling van hierdie plante wat die kern van 'n herbarium sou vorm, bewaar.

'n Plantsiektekundige is in 1905 tot die span gevoeg om graansiektes te bestudeer.

Na Unie was die ontwikkeling vinniger en is die staf aansienlik uitgebrei. By die funksies van die Afdeling Plantkunde en Plantsiektekunde is Tuinbou, Akkerbou, Weiding, Insektekunde, Grondbewaring en Uitbreiding gevoeg, en die hele organisasie het die Afdeling van Plantnywerheid geword. By die hoofkwartier te Vrede Huis was slegs 'n klein botaniese tuin en bykomstige proefstasies om inheemse en ingevoerde plante te ontvang en te toets ten opsigte van hulle landboukundige moontlikhede, is opgerig.

Die skepper van die Afdeling van Plantnywerheid, Dr. I. B. Pole Evans het in 1939 op pensioen afgetree, en dit is toe besluit dat die leiding van die verskillende lyne van navorsing wat hy tot stand gebring het onder onafhanklike Hoofde van Afdelings voortgeset wou word. Op die manier het Tuinbou, Akkerbou en Weiding, Insektekunde, Grondbewaring en Uitbreiding afgeskei en die Plantkunde en Plantsiektekunde seksies was weer op hulle eie. 'n Tydjie later het Plantsiektekunde ook mondig geword en 'n Afdeling op sy eie geword.

Nadat hy hierdie satelliete met welslae afgevuur het, kon die Afdeling Plantkunde sy aandag skenk aan 'n meer eng botaniese navorsingsveld, en so is dit teweeggebring dat plantkundiges in die Nasionale Herbarium, wat grootliks besiggehou word met die opname en klassifikasie van ons inheemse flora, gevoel het dat 'n botaniese tuin, wat die naam waardig sou wees, waarin lewende plante gekweek en waargeneem kan word—'n tuin waarin die moontlikhede van elke soort afsonderlik bestudeer kan word—noodsaaklik geword het. Tegelykertyd sou dit 'n opvoedingssentrum en skoonheidsoord word.

Op hierdie tydstip is die verbond tussen die Afdeling Plantkunde en die Universiteit van Pretoria, waarna ek in die begin verwys het, gemaak.

Sedert die vroegste tye is plante in tuine versorg. Die vroegste tuine het hoofsaaklik te doen gehad met die kweek van geneeskragtige kruie en was werklik die eerste wetenskaplike plantkundige inrigtings. Selfs vandag, hoewel daar so 'n menigte van die nuwe sintetiese medisynes is, is daar nog 'n diep belangstelling in navorsing van die wêreld se plantegroei met die oog op die ontdekking van nuwe medisynes of nuwe bronne van bekende samestellings. Suid-Afrika dra reeds 'n belangrike deel by deur die uitvoer van aalwyn, boegoeolie en diosgenin, wat uit *Dioscoria* verkry word vir die vervaardiging van cortisone, om slegs drie voorbeelde te noem. Op die huidige tydstip is daar 'n skema wat deur handelsbelange in Amerika ondersteun word, om 'n pos vir 'n Afrikanerskeikundige wat die plantegroei van die Unie meer intensief as ooit tevore sal bestudeer, te skep. Die persoon aan wie die pos geskenk word sal van beide die W.N.N.R. en die Afdeling Plantkunde leiding ontvang, en in hierdie tuin waarin ons vanmore saamgekom het, sal plante deur hom versamel en gekweek word.

Wanneer ons die taamlik onlangse geskiedenis van botaniese tuine beskou vind ons dat baie van hulle dwarsdeur die wêreld 'n belangrike rol in die toets en verspreiding van plante wat van ekonomiese belang is, gespeel het. Daar is die beroemde geval van die plantkundige wat toevallig 'n paar sade van die rubberboom in sy natuurlike omgewing in Suid-Amerika versamel het, en hulle na Kew Botaniese Tuin in Engeland gestuur het. Die jong rubberbome wat daaruit gespruit het is toe na die Singapoer Botaniese Tuin gestuur, en uit hierdie klein begin is 'n industrie met 'n geweldige waarde vir die mens, en bepaald baie miljoen pond werd, opgerig. Botaniese Tuine van die wêreld het 'n ewe belangrike rol in die ontwikkeling en uitbreiding van die katoen, kiena en tee-industrieë gehad, en uit Australië het ons die voorbeeld van die uitgebreide koringnywerheid wat ontstaan het vanuit 'n paar sade wat na die Sydney Botaniese Tuin ingevoer is. Ek kan u ook as 'n voorbeeld noem een van ons eie veldgewasse, wat 'n belangrike plek in die landbou buite ons grense ingeneem het, deur die toedoen van wyle Dr. Maria Wilman wie op die flora van Griekwaland-Wes gewerk het. Dr. Wilman het saad van een van ons gewone veldgrasse—een wat destyds geen groot naam in die Unie gehad het nie—na Amerika gestuur. Hierdie gras, *Eragrostis curvula*, het spoedig in die Amerikaanse landbou in die guns geraak, met die gevolg dat dit vandag as weiding en grondverbetering oor groot landstreke gesaai word, en in die algemeen die "Wilman Love Grass" genoem word. Die Amerikaners het reeds verbeterde tipes daarvan by hulle navorsingstasies voortgebring. Die waarde van hierdie gras word nou ook in die Unie meer besef en in die Griekwaland-Oos distrik alleen is reeds meer as 10,000 akker binne die afgelope 8 jaar met Love Grass beplant. Die plantkundige in sy Botaniese tuin was bepaald al in menige ekonomiese belangrike landboukundige sake betrokke.

Ek het met opset u aandag op hierdie paar voorbeelde gevestig, om u te herinner hoe nou die landbou en ons alledaagse voorspoed met plantkunde verbonde is. Sedert die tydperk toe dit slegs van mediese belang was, het die funksies van 'n botaniese tuin egter geleidelik verander. Dit is nog 'n setel van opvoeding en geleerdheid, maar geleidelik het die estetiese aspek na vore getree. Laasgenoemde is ook van groot belang wanneer ons sy invloed op die opbou van ons nasionale kultuur oorweeg. 'n Opgevoede gemeenskap moet besef dat dit sy plig is om op intelligente wyse in die flora van sy land belang te stel. En wat is daar in ons flora om 'n gevoel van nasionale trots aan te wakker?

In die eerste plek kan ons daarop aanspraak maak dat die Unie van Suid-Afrika, in verhouding tot sy grootte een van die rykste floras in die wêreld het. Hier word oor die 20,000 soorte plante gevind. Om 'n paar statistieke te noem het ons ongeveer 500 soorte Erica, 300 soorte Protea en sy verwante, oor 880 soorte grasse, en heelwat meer as 1,500 soorte vygies en ander vetplante.

Die versamel en kweek van vetplante, wat vanaf die vroegste dae toe ontdekkingsreise in die Kaap gedoen is, populêr was, is vandag nog 'n stokperdjie waarin baie spesialiste verdiep is. Daar is 'n aanhoudende belangstelling en handel in hierdie groep, waarin die eindelose verskeidenheid van vorm en kleur altyd 'n bron van bewondering is. Daar is die Aalwyne, die vensterplante wat half begrawe is in harde grond, die klipagtige plante wat op die oppervlakte groei en so harmonies met hulle omgewing saamsmelt dat hulle besonder moeilik is om raak te sien, en 'n menigte ander eienaardige vorms. Nêrens in die wêreld is daar 'n vetplante-flora so ryk soos ons s'n nie.

In sommige droë dele van Amerika is daar 'n groot verskeidenheid cacti, 'n groep wat in die Unie afwesig is; maar die vetplant-flora van die Unie is nie alleen geweldig ryk in soorte nie maar het ook verteenwoordigers in 'n aantal heeltemal onverwante families waarin parallelle ewolusie plaasgevind het.

Maar dit is nie al nie. Die Unie het 'n aansienlike bydrae tot botaniese tuine en tuinbou dwarsdeur die wêreld gelewer, vanuit die seldsame en pragtige flora waarmee die natuur ons so mildelik bedeel het.

Selfs voor die eerste blanke nedersetting aan die Kaap ongeveer 300 jaar gelede, het daar reeds 'n klein handel in Kaapse plante met 'n aantal koninklike tuine in Europa ontstaan. Matrose wat in die tuinbou belanggestel het, het saad en bolle versamel wanneer hulle tydelik geland het. Hoewel van Riebeeck die eerste nedersetters aan die Kaap streng beveel het om nie verder as die Skiereiland te reis nie, is hierdie perke spoedig oorskry. Later het die twee Goewerneurs, Simon en Adriaan van der Stel, vader en seun, spesiale ontdekkingsreise na die binneland georganiseer om onder andere plante en saad te versamel om die beroemde tuine van Holland te verryk.

Gedurende die agtiende eeu was daar 'n standvastige vooruitgang in die invoer van Suid-Afrikaanse plante in Europa totdat, aan die einde van die eeu, dit gesê kon word dat ons Ericas, Proteas, Stapelias en baie bolplante byna die kweekhuise van nie alleen Holland, maar ook van Engeland, Oostenryk, Swede, Italië en Frankryk oorheers het. Tussen die besitters van tuine was daar skerp mededinging om die rykste versameling uitheemse plante te mag besit. Die Kaapse flora was 'n ontsaglike ryk bron om uit te put.

Gedurende die neëntiende eeu het die ambisie om nuwighede te kweek bedaar, en ons Flora het gedeeltelik sy aantrekkingskrag verloor, egter nie voor sulke plante soos Agapanthus, Nerine, Gladiolus, Pelargonium en vuurpyle, varkblomme en selfs sommige van die Namakwalandse madeliefies, blywende plek in die tuine van Europa en die Nuwe Wêreld ingeneem het nie. Terwyl hierdie Suid-Afrikaanse plante oorsee makgemaak is, het hulle die aandag van plantekwekers getrek, met verreikende tuinboukundige gevolge. Onder die kruisings wat eerste in guns geraak het, was die Pelargoniums—gewoonlik onder die naam Geranium bekend—wat tot vandag so uitgebreid in tuine gekweek word. U sal u herinner dat die Geranium Vereniging van Britanje onlangs aan die Unieregering 'n versameling van die beste moderne kruisings geskenk het, as 'n blyk van waardering aan die land van hulle herkoms. Hierdie versameling is nou in bewaring van die Afdeling Tuinbou.

Dan is daar die rooi Barbertonse Madeliefie, wat deur seleksie en kruising 'n byna eindelose verskeidenheid van kleure en dubbelvorms voortgebring het, en wat die besonder goeie hoedanigheid het dat dit so lank in water kan hou. Om die waarheid te sê is daar maar min van ons gekweekte blomme wat hulle oorspronklike vorm behou het. Besoekers aan openbare tuine oorsee dink nie eers om navraag te doen oor die land van oorsprong van die vele tuinboukundige wondere nie.

Is dit dus nie paslik dat ons ons eie flora behoort te eer nie; dit in sy natuurlike toestand moet bestudeer, dit in hierdie botaniese tuin moet kweek en bewaar sodat almal dit kan sien en waardeer nie? Hier sal geen plek vir uitheemse plante wees nie.

Sonder twyfel is daar in die teenwoordige eeu dwarsdeur die Unie 'n algemene oplewing van belangstelling in die kweek van ons inheemse flora. Groot stappe vooruit is gemaak in die openbare tuine van sommige van die groter en heelparty van die kleiner dorpe. Uitgebreide gebiede is opsygesit vir die bewaring van aantreklike en interessante soorte. Dit werk alles ten goede en die neiging behoort soveel moontlik aangemoedig te word, maar uit die aard van die saak is die wetenskaplike toenadering afwesig of slegs tot 'n beperkte mate in ag geneem. Slegs inrigtings soos die Afdeling Plantkunde met sy staf bestaande uit opgeleide plantkundiges en tuiniers kan wetenskaplike studie met die kweek van plante verenig.

Die Nasionale Botaniese Tuin te Kirstenbosch, wat in 1913 tot stand gekom het, het 'n soortgelyke organisasie—'n tuin en 'n opgeleide plantkundige staf. Om die waarheid te sê word dwarsdeur die wêreld die kombinasie van 'n botaniese tuin met 'n herbarium en biblioteek erken as die ideale organisasie om plantkunde as wetenskap te bevorder.

Die Nasionale Botaniese Tuin te Kirstenbosch het tans 'n wêreldwye reputasie deur sy pragtige omgewing en groot natuurlike skoonheid. Sy reputasie is onlangs verder bevorder deur die toekenning van 'n goue medalje op 'n internasionale blommeskou in New York vir 'n versameling van Suid-Afrikaanse blomme wat hoofsaaklik uit Proteas bestaan het. Kirstenbosch kan egter nie 'n beeld gee van die flora van die hele Unie nie. Geen enkele inrigting sou dit kon doen nie.

Soos u almal weet word die Unie volgens klimaat in 'n oorwegende winterreënvalstreek en 'n oorwegende somerreënvalstreek verdeel, met 'n betreklik klein streek met reën dwarsdeur die jaar in die George-Knysna gebied. Soos te begryp is die flora van die twee hoofgebiede baie verskillend. Kirstenbosch, wat 'n hoë winterreënval geniet, is dus die mees gepaste plek om die flora van daardie gebied te bestudeer. Die plantegroei van die somerreënvalstreek is nie daar tuis nie, en dit is hierdie afdeling wat die meeste aandag in hierdie nasionale Botaniese Tuin sal geniet. Die Afdeling Plantkunde wil egter nie sy ambisie verswyg om ook sukses met sommige van die Kaapse plante te behaal nie, en aan my is meegedeel dat hierdie plan bevorder word deur Mev. Vogts, wat self vanmore hier aanwesig is, en self in Pretoria sukses daarmee behaal het na vroeëre ondervinding aan die Kaap.

Die gedagte het seker al by meeste van u verrys dat die ontwikkeling van 'n botaniese tuin met die bou van 'n nasie vergelyk kan word. Die stigters het hulle ideale en strewe; hulle lê die fondament, maar sien selde hulle arbeid tot volle bloei kom. Vandag lê ons dus spreekwoordelik die hoeksteen van 'n gebou wat baie jare sal neem om sy volle grootte te bereik. As simbool van die strewe van die Afdeling Plantkunde is ek gevra om 'n inheemse boom as aandenking aan hierdie geleentheid te plant. Die groei en ontwikkeling van die boom wat jaar na jaar in grootte en skoonheid sal toeneem, sal 'n inspirasie wees vir latere geslagte van tuiniers en plantkundiges. En met hierdie vooruitsig waarin ons ten volle vertroue het doen dit my genoeë om hierdie Nasionale Botaniese Tuin oop te verklaar. Ons sal nou voortgaan om die boom te plant."

"The ground we are standing on this morning is part of the Pretoria University farm—part of the farm set aside for the Faculty of Agriculture. It is now a little over ten years ago that the University Council agreed to the establishment of a botanic garden on this site. Botany, it will be appreciated, is one of the basic courses in the first year curriculum of all students taking Agriculture, so there is every reason why there should be close collaboration between the Faculty and the Division of Botany.

It gives me great pleasure on this historic occasion of the official opening of this botanic garden to thank the Rector—Professor Rautenbach—and the Council of the University for their far sighted policy in fostering this development. The area is approximately 68 morgen in extent. You have only to glance round to appreciate what an

excellent site it is for a botanic garden. It is readily accessible. It is on the national road from Pretoria to the eastern Transvaal and the Kruger National Park. Along this route more and more overseas visitors will travel and see this display window of our indigenous flora. It will be constantly in the public eye.

In this garden there are north and south facing slopes; there is a large undulating area of deep sandy soil, and there is this fine koppie behind me which dominates the whole site and from which one can survey a wide expanse of Pretoria. Or one can gaze and ponder about what goes on across the road in that imposing array of buildings erected by the Council for Scientific and Industrial Research. Yes, this is a truly stimulating environment and we can expect this garden to become a place of pride in years to come.

Botany in its broad sense knows no boundary between such subjects as Horticulture, Plant Pathology, Pasture Research, Veld Management, Plant Physiology and Plant Breeding. Botany serves them all. When a new territory is opened up one of the first duties is to take stock of the wealth of the indigenous vegetation. It is the composition of the natural undamaged veld which affords the best indication of how the land should be utilised for the maximum agricultural output.

My farming friends are well aware of the continuous efforts of the Department for more efficient land utilisation. They are aware of the report on this subject by the Division of Economics and Markets. The field officers of the Division of Botany played an important part in this project in demarcating veld types and their distribution.

The farmer himself must know his veld. He must know as many as possible of the individual plants which go to make up his veld. He must know the good fodder plants, those to be encouraged and protected against overgrazing. He must know also the poisonous plants which are a constant menace to his stock. The Division of Botany has a good store of information on these subjects but can never find out all there is to know in such a vast field of study. Our knowledge is never complete. Plants from the veld will be introduced into this garden for further study and the information obtained, will, as in the past, be made available to the farming community and general public both in the Union and oversea.

The history of Agriculture in the Union dates back to the arrival of Jan van Riebeeck at the Cape in 1652. One of his first duties was to establish a garden for the cultivation of vegetables to supply trading vessels of the Dutch East India Company on their way to and from the East Indies. The History of Agriculture in the Transvaal, however, covers a very much shorter period and begins shortly before 1900. Some of the early events are of general interest and relevant to the present occasion. In 1896 the Volksraad appointed a veterinarian, Arnold Theiler, to combat the scourge of Rinderpest which was then raging. A botanist, Burtt Davy, was appointed in 1903. Thus it was that the Department of Agriculture in the Transvaal had its beginning in the appointment of a veterinarian and a botanist. The duty of the botanist was to go out into the veld, to meet farmers and discuss the agricultural needs of the different areas. to study the fodder plants of the natural veld, the poisonous plants, noxious weeds and any plant which might have some economic value. In addition he had to preserve for permanent record representative collections of these plants as the nucleus of a herbarium.

A Plant Pathologist was added to the team in 1905 to study cereal diseases.

After Union there was more rapid development and considerable staff expansion. To the functions of the Division of Botany and Plant Pathology were added Horticulture, Crops, Pastures, Entomology, Soil Conservation and Extension, and the whole organisation became the Division of Plant Industry. There was only a small botanical garden

at the headquarters at Vrede Huis and additional experimental stations were established to receive indigenous and introduced plants where they could be tested for their agricultural potentialities.

The Architect of the Division of Plant Industry, Dr. I. B. Pole Evans, retired on pension in 1939, when it was decided that the direction of the several lines of research which he had initiated should be placed under independent Chiefs of Divisions. Thus Horticulture, Crops and Pastures, Entomology, Soil Conservation and Extension hived off leaving the Sections of Botany and Plant Pathology on their own again. Sometime later Plant Pathology also attained its majority and became a fully fledged Division.

Having successfully launched these important satellites the Division of Botany was set to concentrate on a more strictly botanical field of research, and so it was that botanists in the National Herbarium, who are largely occupied with the stocktaking and classification of our indigenous flora, felt the need of a botanical garden, worthy of the name, in which to grow and observe plants in their living state—a garden in which to study the potentialities of each individual species. In would be at the same time an educational centre and a place of beauty.

It was at this stage that the alliance was made between the Division of Botany and the University of Pretoria to which I referred at the outset.

From time immemorial plants have been cared for in gardens. The earliest gardens were concerned mainly with the cultivation of herbs with medicinal properties and were in fact the first scientific botanical institutions. Yet even today, with the spate of new synthetic drugs there is still an intense interest in the exploration of the vegetation of the world for the discovery of new drugs or new sources of known compounds. South Africa is already making valuable contributions by the export of " aloes ", " buchu oil ", diosgenin, from *Dioscorea* for the manufacture of cortisone, to mention only three examples. There is now on foot a scheme sponsored by commercial interests in America to create a Fellowship for a South African to explore the chemical properties of the flora of the Union more intensively than ever before. The holder of the Fellowship will receive direction from both the C.S.I.R. and the Division of Botany, and this garden, in which we are gathered this morning, will receive any plant material which shows promise of beneficial properties.

If we look into the fairly recent history of botanical gardens we find that many of them throughout the world have played an important part in the trial and distribution of plants of economic importance. There is the famous case of the botanist casually collecting a few seeds of the rubber tree in its wild habitat in South America and sending them to the Kew Botanic Gardens in England. The resulting young rubber trees were then forwarded to the Singapore Botanic Gardens, from which small beginning an industry of immense value to mankind, and certainly one worth many millions of pounds, has been established. Botanical Gardens of the world played an equally important part in the development and expansion of the cotton, quinine and tea industries, and from Australia we have the example of the extensive wheat industry being founded on a few seeds introduced into the Sydney Botanic Gardens.

I can give you an example also of one of our veld plants gaining a place of importance in agriculture beyond our borders through the action of the late Dr. Maria Wilman who worked on the flora of Griqualand West. Dr. Wilman sent seed of one of our ordinary veld grasses—one with no great reputation in the Union at the time—to America. This grass, *Eragrostis curvula*, soon found favour in American agriculture, with the result that today it is sown as a pasture and soil improver over vast areas, and is commonly referred to as the ' Wilman Love Grass '. The Americans have, in fact, already produced improved strains at their experimental stations. The value of

the grass is now appreciated more in the Union too, and in the Griqualand East district alone over 10,000 acres have been planted with Love Grass within the last 8 years. The botanist in his botanical garden has certainly had a finger in many a rich agricultural pie.

I have purposely drawn your attention to these few examples to remind you how intimately Agriculture and our every day welfare have been linked with the subject of botany. The functions of botanical gardens have, however, undergone a gradual change since the days of the purely medicinal concept. It is still a seat of learning and education and gradually the aesthetic aspect has gained prominence. This is also of great importance when we weigh its influence in the building up of a national culture. An educated community must recognise that it is its duty to take an intelligent interest in the flora of the country in which it lives.

And what have we in this flora of ours to inspire a national pride?

For a start we can claim that, for its size the Union of South Africa has one of the richest floras in the world. It supports nearly 20,000 species. To mention a few statistics we have about 500 species of Erica, 300 species of Protea and its allies, over 800 species of grass and well over 1,500 species of vygies and other succulents.

The collection and cultivation of succulents, which was popular from the earliest days of exploration at the Cape, is still an absorbing hobby for many specialists. There persists a steady interest and trade in this group in which the infinite variety of form and colour is a continual source of wonder.—There are the Aloes, the window plants half buried in hard ground, the stone-like plants growing on the surface and blending so harmoniously with their surroundings that they are extremely difficult to detect, and a host of other curious forms. Nowhere in the world can our succulent flora be matched for its richness.

Some arid areas of the Americas boast a great variety of Cacti which are absent from the Union, but the succulent flora of the Union is not only immensely rich in species but is represented in a number of unrelated families in which there has been parallel evolution.

But this is by no means all. The Union has contributed handsomely to botanical gardens and horticulture throughout the world from the rare and beautiful flora with which nature has so lavishly endowed us.

Even before the first European settlement at the Cape about 300 years ago, there had developed a small traffic in Cape plants to several royal gardens of Europe. Sailors with an interest in horticulture had gathered seed and bulbs during temporary landings. And although the first settlers at the Cape were given strict instructions by van Riebeeck to confine their waderings to the Peninsula, it was not long before these bounds were broken. Later the two Governors, Simon and Adriaan van der Stel, father and son, organised special expeditions into the interior in order, among other things, to collect plants and seed to enrich the famous gardens of Holland.

Steady progress with the introduction of South African plants to Europe was made during the 18th century, until towards the end of the century, our Ericas, Proteas, Stapelias and many bulbous plants, may be said almost to have dominated the green-houses, not only of Holland but of England, Austria, Sweden, Italy and France. There was great rivalry among the owners of gardens to claim the richest collection of rare plants from foreign lands. The Cape Flora was a tremendously rich reservoir from which to draw.

During the 19th Century the ambition for novelty subsided and our Flora lost some of its attraction; not, however, before such subjects as Agapanthus, Nerine, Gladiolus, Pelargonium, the red hot pokers, Arum lilies, and even some of the Namaqualand daisies, had earned for themselves a permanent place in the gardens of Europe and the New World. During their domestication overseas these South African plants attracted the attention of plant breeders with far reaching horticultural results. Among the earliest hybrids to gain favour were the Pelargoniums—popularly referred to as Geraniums—which are so extensively used to this day. It will be recalled that the Geranium Society of Great Britain quite recently presented the Union Government with a collection of the best modern hybrids as a token of gratitude to the Country of their origin. This collection is now under the care of the Division of Horticulture.

Then there is the red Barberton daisy, which by selection and hybridisation has yielded an almost endless variety of shades and double forms, whose lasting quality as a cut flower is a special asset. There are in fact very few of our cultivated flowers which have retained their original purity. Visitors to public gardens overseas take so many of these wonders for granted that few pause to enquire about the country of origin.

Is it not fitting therefore that we should honour our own flora, study it in its natural condition, cultivate and preserve it in this botanical garden for all to see and appreciate? There will be no place here for exotics.

There is no doubt that the present century has seen a general awakening of interest in the cultivation of our indigenous flora throughout the Union. Rapid strides have been made in the public gardens of some of the larger and several of the smaller towns. Extensive areas have been set aside for the preservation of attractive and interesting species. This is all to the good and the trend should be encouraged as much as possible; but in the nature of these undertakings the scientific aspects are absent or, at best, observed only to a limited degree. It is only institutions such as the Division of Botany with a staff of trained botanists and gardeners that can combine scientific study with the art of cultivation.

The National Botanic Garden of Kirstenbosch established in 1913 has a similar organisation—a garden and a trained botanical staff. In fact thoughout the world the combination of a botanical garden with a herbarium and library is recognised as the ideal organisation for the advancement of botanical science.

The National Botanic Garden at Kirstenbosch has earned for itself a world-wide reputation for its magnificent setting and its great natural beauty. Its reputation was enhanced still further recently by the winning of a gold medal award at an international wild flower show in New York for a collection of South African flowers consisting mostly of Proteas. But Kirstenbosch cannot feature the whole of the Union's flora. No single institution could do so.

As you all know the Union is divided climatically into a predominantly winter rainfall region and a predominantly summer rainfall region, with a relatively small region of equal proportions of winter and summer rainfall in the George–Knysna area. As one could guess, the flora associated with the 2 main regions is distinctive. Thus Kirstenbosch, which enjoys a high winter rainfall, is suited best for the study of the flora of that region. The summer rainfall flora is not at home there and it is this section which will receive most attention in this Botanic Garden in Pretoria. The Division of Botany does not disguise its ambition, however, to achieve success with some of the Cape specialities, and I have been told that this project is fostered by Mrs. Vogts, who is present this morning, and has herself had success in Pretoria after earlier experience at the Cape.

It must have occurred to most of you that the development of a botanical garden has a likeness to the building of a nation. The founders have their ideals and aspirations; they set the foundation, but rarely see the full harvest of their labours. Thus today, we are, so to speak, laying the foundation stone of an edifice which will take many years to reach maturity. As a symbol of the ambition of the Division of Botany I have been asked to plant an indigenous tree to commemorate this occasion. The growth and development of the tree—year by year gaining in stature and beauty—is to be an inspiration to future generations of gardeners and botanists. And on this note of confident expectation, I have pleasure in declaring this national Botanic Garden open. We shall now proceed to the planting of the tree."

One of the staff said later: While we entertained our guests to tea some phrases of the Minister's address seemed to linger on the air- a botanical garden worthy of the name, in which to grow and observe our plants in their living state—in which to study the potentialities of each individual species—a garden that would be at the same time an educational centre and a place of beauty.

Now we look forward to the building of a new herbarium on a site within the new botanic garden. It is sorely needed.

The title Pretoria National Botanic Garden—Pretoria Nasionale Botaniese Tuin—was approved by the Council of the Pretoria University and by the Department of Agriculture (Technical Services) in 1959.

Notes on some South African species of the Genus Euclea

By

B. de Winter.

Euclea crispa, E. lanceolata, E. ovata and some hybrids.

The fact that *Celastrus crispus* Thunb. represents a species of *Euclea* was realised by Sonder who states in a note in Harvey & Sonder Fl. Cap. 1: 461 (1859–60) " Celastrus crispus Thunb. = Eucleae (Ebenac) ". Later this was taken up by Guerke in Pflanzenfamilien 4, 1: 158 (1891) who credited the combination to Sonder.

Under the modern Rules of Botanical Nomenclature a new combination is only valid if the combination is actually made, hence in the present case, Guerke not Sonder is the effective author.

Guerke regarded *Celastrus crispus* as representing the same species as *E. ovata* Burchell, Pflanzenfam. 4, 1: 158 (1891). When the type specimen of *C. crispus* was examined by me, it was found to agree more closely with the type of *E. lanceolata* E. Mey. ex DC. However, Hiern, in the Fl. Cap., and later Sim, in his Forest Flora of Cape Col. p. 262, noted that *E. lanceolata* and *E. ovata* cannot easily be distinguished. I have failed to find sufficient difference to justify keeping them as distinct species.

I regard *E. lanceolata* to be a synonym of *E. crispa* and *E. ovata* a variety of *E. crispa*.

Euclea crispa (*Thunb.*) *Sond.* ex *Guerke*, aggregate species.

(*a*) var. **crispa.**

E. crispa (Thunb.) Sond. ex Guerke in Pflanzenfam. 4, 1: 158 (1891). Type: Cape, *Thunberg* s.n. *E. lanceolata* E. Mey ex DC. Prodr. 8: 217 (1844); Hiern in F.C. 4, 1: 467 (1906). Type: Klipplaat River, *Drege* s.n.

Celastrus crispus Thunb. in Hoffm. Phytogr. Blätt 1: 23 (1803).

(*b*) var. **ovata** (*Burch*) *de Winter* comb. et stat. nov.

E. ovata Burch. Trav. S. Afr. 1: 387 (1822); Hiern in F.C. 4, 1: 468 (1906). Type: Hay, Sluipslang, *Burchell* 1706.

When studying the var. *ovata* it was found that the leaves of some specimens are indistinguishable from the leaves of *E. coriacea*, a species very different in its floral characteristics. The undulate margin, indumentum and acute apex of the leaves of var. *ovata* are reminiscent of *E. coriacea*, and the area of distribution is so situated that the idea that var. *ovata* originated due to hybridization between *E. coriacea* and *E. crispa* presents itself. The floral structure, however, offers little evidence for the suggestion since the flowers of the var. *ovata* have deeply cleft corollas, quite unlike those of *E. coriacea*, in which the corollas are only very shallowly lobed. One could assume that the gene for a deeply cleft corolla is dominant. In some forms of *Euclea natalensis*, which, on the evidence available, can only be regarded as the result of hybridization between *E. natalensis* and *E. tomentosa*, the same obstacle presents

itself. Here again the acceptance of the deeply lobed corolla as being controlled by a dominant gene will give a reasonable explanation of the abscence of plants with intermediate floral characteristics. Should the presence of this dominant gene be accepted, it is clear that the var. *ovata* could have acquired some of the leaf characteristics of *E. coriacea* by introgressive hybridization, while the flowers have remained more or less unaltered and resemble those of *E. crispa*. *E. coriacea* has on the other hand apparently remained unchanged, a fact which could be regarded as evidence against hybridization having taken place. It is significant, however, that the studies of Stebbins and others on hybridization and its effects (Variation and Evolution in Plants 1950) offer examples which agree almost in detail with the case discussed here (Chap. 7: 262–265).

On the importance of the environment for the success of hybridization I quote Stebbins: " Hybridization between well-established and well-adapted species in a stable environment will have no significant outcome or will be detrimental to the species populations. But if the crossing occurs under rapidly changing conditions or in a region which offers new habitats to the segregating offspring, many of these segregates may survive and contribute to a greater or lesser degree to the evolutionary progress of the group concerned ".

According to Acocks in Veld Types of S. Afr., Bot. Survey Mem. No. 28, the Karroo vegetation has advanced considerably eastward since the advent of man in the southern tip of Africa. When the maps drawn up by Acocks depicting conditions in 1400 A.D. and 1950 A.D. are superimposed, the supposed original boundary between Karroo and tropical grassveld and the actual boundary in 1950, enclose an area which agrees in remarkable detail with the area of distribution of var. *ovata*. It can be inferred that conditions in this area, which can be regarded as transitional, are unstable and offer a range of new habitats. On the other hand it seems unlikely that the var. *ovata* is of very recent origin, which suggests that the unstable conditions of this area go back to much earlier times than estimated by Acocks.

Another possibility is that the var. *ovata* has become better adapted to arid conditions than either of its parents, due to a recombination of characters. In this case the distribution may be mainly determined by rainfall. The distribution of rainfall, however, does not agree nearly as closely as the former with the area of distribution of the var. *ovata*, nor does geological data combined with rainfall offer a better solution.

Euclea schimperi, E. daphnoides and E. macrophylla.

An examination of the Abysinnian species *E. schimperi*, shows that the two S.A. species *E. macrophylla* and *E. daphnoides* are not specifically distinct from it. *E. macrophylla* agrees in all essentials, but *E. daphnoides* differs somewhat in the shape and texture of the leaves; these are narrower and often become thicker and more coriaceous than those of typical *E. schimperi*. *E. macrophylla* is, therefore, placed in synonymy under *E. schimperi* and *E. daphnoides* is reduced to varietal rank in the same species:—

E. schimperi (*A. DC.*) *Dandy*, aggregate species.

(a) var. **schimperi.**

E. schimperi (A. DC.) Dandy in Andrews Flow. Pl. Anglo-Egypt. Sudan 2: 370 (1952). Type: Abyssinia, *Schimper* s.n. *E. Kellaua* Hochst. in Flora 26: 83 (1843). *E. macrophylla* E. Mey. ex A. DC. Prodr. 8: 218 (1844); Hiern. in F.C. 4, 1: 472 (1906). Type: Cape, between Kei and Bashee Riv., *Drege* s.n. *E. racemosa* Murr. var. *burchellii* Hiern. in F. C. 4, 1: 474 (1906).

Kellaua schimperi A. DC. in Ann. Sc. Nat. 2, 18: 20 (1842).

(*b*) var. **daphnoides** (*Hiern.*) *de Winter* stat. nov. *E. daphnoides* Hiern in Trans. Cambr. Phil. Soc. 12: 102 (1872): and in F.C. 4, 1: 42 (1906). Lectotype: Humansdorp, *Burchell* 4909. (I nominate the sheet at Kew, *Burchell* 7/4909/, „western bank of the Wagenbooms River on the north side of Lange Kloof", a female specimen, as the type of *E. daphnoides* Hiern).

6096259—7

Notes and New Records of African Flowering Plants.

By

Various Authors.

ACANTHACEAE.

Justicia minima *A. Meeuse*, nom. nov.—*J. spergulaefolia* sensu C. B. Clarke in Dyer, Fl. Cap. 5, 1: 60 (1901), non T. Anders. Type: *Schlechter* 4267 (K, holo.!, PRE, iso.!).

A number of specimens of a *Justicia* had been collected in the Transvaal, which run in the key in Flora Capensis to "*J. spergulaefolia*" and indeed match *Schlechter* 4267 (PRE), the only gathering cited by Clarke. All these specimens, including the type gathering, came from a fairly restricted area in the Warmbaths, Waterberg and Potgietersrust districts of the Transvaal and it was felt that they might not be conspecific with the type of *J. spergulifolia* which was collected in Damaraland. Mr. W. Marais borrowed the holotype of the latter from T.C.D. (Dublin) and reported that it is undoubtedly a species of *Monechma*, probably *M. namaense* C. B. Clarke. The Transvaal specimens referred to above appeared to be without a valid name and the name "*minima*" was chosen because this reflects the very slender habit of this plant and the small flowers.

Characteristic of this species is the varying degree of pubescence. Specimens which are almost or completely glabrous are growing side by side with specimens which are rather densely pubescent with short stiff hairs. Very glabrous specimens also have glabrous inflorescences, but very hairy ones have a pubescent rhachis, pubescent bracts, bracteoles and calyx-segments.

The species can be best characterised as a miniature of the tropical African *J. linearispica* C. B. Clarke, which it resembles in habit, in the shape of the leaves and in the inflorescence, but all parts are considerably smaller. *J. minima* grows almost invariably in rock crevices on quartzite.

TRANSVAAL.—Locality not quite certain, but probably Potgietersrust district: Magalakwin River, *Schlechter* 4267 (K. holo!, PRE, iso!). Potgietersrust: between Bokpoort and Palala Heights, *Meeuse* 9349. Waterberg: Vyeboom near Nylstroom, *Meeuse* 9334, 9334a; near Naboomspruit, *Meeuse* 9736. Warmbaths: Hills North of Warmbaths on road to Nylstroom, *Smuts* and *Gillett* 3314, *Codd* 3448, *Repton* 793, *Sidey* 1329. (All cited specimens in PRE).

Justicia montis-salinarum *A. Meeuse* spec. nov. ex affinitate *J. orchioides* L.f., *J. odorae* Vahl, *J. philipseae* Rendle et *J. lorteae* Rendle, sed inter alia habitu, indumento puberulo, foliis linearibus, corolla extus pubescenti, capsula minute denseque hirtiuscula differt.

Suffrutex perennis densus multicaulis ramosissimus habitu semigloboso 30–60 cm. altus. *Caules* plurimi lignosi subteretes glabrescentes cortice griseo sublevi vel ubrugoso obtecti, ramulis ulterioribus flavo-viridibus suffruticosis subquadrangulatis

densissime minuteque puberulis vel farinosis, internodiis 1–2 cm. longis. *Folia* linearilanceolata subrigida integra sessilia subacuta subpungentia minute puberula in siccitate flavo-viridia 10–25 mm. longa et 1–2·5 mm. lata, nervo medio subtus prominulo. *Flores* solitarii in axillis foliorum superiorum sessiles. *Bracteolae* 2 lineari-lanceolatae attenuato-acutae minute hirtiusculae uninerves 5–6 mm. longae c. 0·75 mm. latae. *Calyx* profunde 5-fidus, firmiter herbaceus, dense minuteque hirtiusculus, tubo c. 1 mm. longo, lobis erectis subaequalibus lineari-lanceolatis attenuato-acuminatis uninervibus c. 4 mm. longis 0·5–0·75 mm. latis. *Corolla* alba intus in faucibus purpureo-maculata, extus dense minuteque strigoso-pubescentis intus in faucibus sparse pilosula, 8–9 mm. longa, labio antico 3-lobato in faucibus transverse ruguloso cum lobo mediano suborbicularibus lobis lateralibus oblongo-rotundis, labio postico concavo leviter emarginato. *Stamina* in faucibus affixa, filamentis ad basin pilosulis, loculis antherarum inferioribus distincte caudatis, granulis pollinis ut in *Justicia*, poris 3 instructis. *Ovarium* ad apicem hirtiusculum, stylo infra medium sparse pilosulo. *Capsula* dilute ochracea, dense minuteque strigoso-hirsutula, stipitata, 8–9 mm. longa, parte stipitata complanata c. 3·5 mm. longa. *Semina* rufo-brunnea tumida papilloso-verruculosa, c. 2·5 mm. longa, 1·5 mm. lata, 1·25 mm. crassa.

Transvaal.—Soutpansberg: Vivo, schoolgrounds, *Mogg* 24448 (PRE, J); slopes of Soutpansberg near Saltpan, *Obermeyer, Schweikerdt & Verdoorn* 168 (PRE); southern entrance of Sandrivierspoort, about 4 miles north of main road bridge, *Meeuse* 10213 (PRE, holo.!).

Erect perennial suffrutex, greyish to subcanescent in appearance when fresh, forming semi-globose densely tufted bushes 30-60 cm. tall. *Stems* numerous, much-branched from the base up, the older parts woody, subterete, grey, with a smooth or faintly longitudinally wrinkled bark; ultimate ramifications wiry, subquadrangular, yellowish-green when dry, finely puberulous to farinose; internodes 1–2 cm. long. *Leaves* linear-lanceolate, stiff, entire, sessile, subacute to subpungent, thinly puberulous or farinose, drying yellowish-green, 10–25 mm. long and 1–1·5 mm. broad; midrib prominent on lower surface, remaining venation consisting of a sinuous marginal vein connected by a few (usually 3–6) short transverse lateral veins with the midrib, prominent on lower surface, indistinct on upper surface. *Flowers* solitary, sessile in upper leaf-axils, almost running into a sparse leafy terminal spike; bracteoles 2, linear-lanceolate, resembling the leaves in shape and texture, attenuate-acute, 1-nerved, 5–6 mm. long and about 0·75 mm. broad. *Calyx* deeply 5-fid, the same colour as the leaves, densely covered outside with very short stiff bulbous-based hairs and inside mainly in the upper part; tube about 1 mm. long; lobes erect, equal, linear-lanceolate, attenuate-acuminate, about 4 mm. long and 0·5–0·75 mm. broad at the base. *Corolla* white with purple markings in the throat, outside densely pubescent with stiff short hairs, inside with a few stiff hairs in the throat, 8–9 mm. long; anticous (lower) lobe 3–lobed with the middle lobe subrotundate and the lateral lobes oblong, rounded at the apex; the throat on this side transversely rugulose; posticous (upper) lip concave, with a rugula containing the style, slightly emarginate. *Stamens* with a few stiff hairs near the base of the filaments; lower anther-cells with a long nearly straight tail; pollen of the *Justicia*-type, ellipsoid, 3-colporate. *Ovary* glabrous except near the top; style shortly and thinly pilose in lower half. *Capsule* pale ochre, densely strigose-hirsutulous with short stiff usually retrorse hairs, stipitate, 8–9 mm. long of which 3·5 mm. taken up by the " stalk ". *Seeds* rather thick, elliptic-subquadrate in outline, of a somewhat reddish brown colour, finely and rather evenly papillose-verrucose, about 2·5 mm. long, 1·5 mm. broad and 1·25 mm. thick.

This rather insignificant *Justicia* belongs to a group of species which have axillary flowers not forming a distinct terminal inflorescence but sometimes running into a leafy sparse spike which is not clearly separable from the remainder of the stem (section

Calophanoides of Fl. Cap. and Fl. Trop. Afr.). In this group it must be placed in the affinity of the shrubby perennial species such as *J. orchioides* L.f., *J. odora* Vahl, *J. phillipseae* Rendle and *J. lorteae* Rendle, but it differs from the first two in the smaller flowers and the narrow leaves, from the other two among other things in the pubescence, hairy corolla and hairy capsule. The pollen is of the *Justicia*-type (Knötchenpollen of Lindau), with three germination pores.

The first gathering was apparently by *Obermeyer* c.s. twenty years ago, but the material was rather scanty and nobody ventured a description. Recent gatherings provided ample material and field-notes. The specimens *O.S.V.* 198 and *Meeuse* 10213 were compared at Kew and reported by Mr. W. Marais to be unmatched.

This plant is easily recognised in the field by its very dense low bushy habit which is not found in other species of the genus occurring in Southern Africa. It seems to prefer warm, dry and rocky situations and has so far only been found in a fairly small area comprising some drier localities in the foothills of the western part of the Soutpansberg range. It is not gregarious, the specimens gathered being apparently taken from single individual plants, and it is probably rare, but a careful search for this not very conspicuous species in suitable localities may prove that it is more wide-spread than the present records indicate.

Petalidium (Sect. *Petalidium* = Sect. *Haplanthus* Lindau) **luteo-album** *A. Meeuse*, spec. nov. ex affinitate *P. linifolii* T. Anders. et *P. lucentis* Oberm. sed inter alia foliis ellipticis vel oblongis (nec linearibus nec lineari-lanceolatis), floribus haud lilacinis, bracteis nec atri- nec purpurei-venosis differt.

Frutex glaber densus multiramosus habitu semigloboso, 0·50–1 m. altus. *Caules* lignosi cortice griseo vel atri-purpureo obtecti, ramulis ulterioribus subdense foliosis viridibus vel albescentibus. *Folia* firmiter herbacea in siccitate pergamacea, flavoviridia, elliptica vel oblonga, integra, obtusa vel subacuta interdum minute apiculata, 2–3·5 cm. longa, 0·5–1·5 cm. lata, cystolithis indistinctis raro infra conspicuis, petiolis brevibus ad c. 6 mm. longis. *Flores* axillares, solitarii, pedicellis gracilibus curvatis vel sinuatis 4–7 mm. (post anthesin ad 12 mm.) longis, bracteolis 2 planis late cordatis asymmetricis submembranaceis vel papyraceis dilute albo-viridibus interdum plus minusve purpurascentibus abrupte apiculatis subglabris integris distincte denseque reticulato-venosis 2·5–3 cm. (post anthesin ad 4·5 cm.) longae et latae. *Calyx* viridis, 5-fidus, tubo 2–3 mm. longo, lobis erectis inaequalibus linearibus acutis minute sparseque glanduloso-puberulis ciliatisque 6–10 mm. longis. *Corolla* dilute flava labio antico flavo, in faucibus fuscovariegata, extus praecipue infra medium et ad nervos sparse adpresse pubescens, intus ad basin loborum pilis albidis rigidis retrorsis paucis sparsim strigosa, tubo (parte cylindrata) c. 10 mm. longo 3 mm. lato, faucibus (parte infundibuliformi) c. 15 mm. longis ad apicem c. 15 mm. latis, lobis 4 posticis subrotundis c. 8 mm. longis et latis, lobo antico late orbiculari-rhomboideo truncato emarginato c. 11 mm. longo 8 mm. lato. *Capsula* fusca glabra subnitida apiculata, 11–12 mm. longa, c. 6 mm. lata. *Semina* 1–2, 6 × 4 mm.

South West Africa.—Kaokoveld Reserve: Okonjombo, *Watt* O.P. No. 2732/G (PRE); near Orupembe (Anabib), *Story* 5730 (PRE, K); 20 m. W. of Otjiku on road to Orumpembe, *de Winter & Leistner* 5683 (PRE, holo.! ; isotypes to be distributed to K, M, Windhoek, B, SRGH and elsewhere).

A much branched rounded shrublet 0·50–1 m. tall. Older stems woody, terete, somewhat swollen at the nodes, grey to rather dark purplish grey, nearly smooth but here and there with a few small and slightly raised circular white lenticels, ultimate branchlets mostly appearing as short lateral shoots, green or ash-grey to white, glabrous or puberulous when still very young, rather densely leafy and bearing the solitary flowers in the leaf-axils. *Leaves* firm, yellowish-green when dry, more pale greyish green when

fresh, elliptic or oblong, entire, obtuse with rounded or minutely apiculate apex, gradually narrowing at the base, very soon quite glabrous, 2–3·5 cm. long and 0·5–1·5 cm. broad; cystoliths in dried leaves indistinct or occasionally discernible on lower surface; midrib slender, prominent on lower surface, lateral veins usually only 2–3 on either side, finer nervation almost invisible except in the youngest leaves; petioles short, some attaining 6 mm. *Pedicels* slender, curved (usually upwards) or sinuous, 4–7 mm. in fruit up to 12 mm. long. *Bracteoles* very large, flat, greenish-cream sometimes more or less suffused with purple, orbicular-cordate, abruptly and sharply apiculate with asymmetrical cordate base and more or less triangular rather narrow basal sinus, entire, papyraceous and rather brittle when dry, nearly glabrous except for a rim of a sparse very short pubescence near the margin inside, with a distinct midrib and a fine reticulate nervation, 2·5–3 cm. long and broad under open flowers, in fruit enlarging to 4·5 × 4·5 cm. *Calyx* green, 5-fid; the tube 2–3 mm. long; lobes linear, erect, acute, minutely and sparsely glandular-puberulous and ciliate, unequal in length, 6–10 mm. long, the tube in fruit elongating to 4 mm., the longest lobes to 12 mm. *Corolla* pale-cream with brown markings inside in lower side of throat and the lower (anticous) lip yellow; outside, mainly below the middle and on the veins, shortly and sparsely pubescent, inside with a few white stiff retrorse hairs at the bases of the lobes; the cylindrical part of the tube about 10 mm. long and 3 mm. in diam., the funnel-shaped portion (throat) about 15 mm. long and as much in diam. at the mouth; four posticous lobes suborbicular, about 8 × 8 mm.; the anticous (lower) lobe broadly-orbicular-rhomboid, truncate and emarginate at the apex, about 11 mm. long and 14 mm. broad. *Capsule* brown, rather shiny, apiculate, 11–12 mm. long and 6 mm. broad. *Seeds* 1 or 2, much compressed, about 6 × 4 mm.

This very distinct species was, as far as can be ascertained, collected for the first time by Dr. J. Watt, now Director of Agriculture, Windhoek, about twenty years ago when he was a Government Veterinary Officer. The two more recent gatherings provided ample material for the description.

It is a typical representative of the genus even in such minute details as the pubescent style. The solitary axillary ebracteate flowers with deeply 5-fid calyx indicate its place in the section *Petalidium* (= *Haplanthus* Lindau). Its nearest affinities appear to be with *P. linifolium* T. Anders. and *P. lucens* Oberm. which also possess large, flat and reticulate-veined bracteoles, but it differs in several respects such as broader leaves, a different colour of the corolla (which is mauve or bluish in the other species) and the concolorous (not blackish or purple, discolorous) venation of the bracteoles. The specimen *Story* 5730 was compared at Kew and the British Museum herbarium by our officer at Kew, Mr. W. Marais who reported that this plant is not represented in either herbarium and confirmed my conclusion that there is no other described species whose diagnosis could possibly apply to the Kaokoveld plant.

The specific epithet chosen refers to the colouring of the corolla, although it should be mentioned that cream or yellow colours are found in the corollas of several species of *Petalidium;* however as far as all available records show, the combination of cream and yellow in a single flower has not been observed in previously described species.

Rhinacanthus xerophilus *A. Meeuse*, spec. nov., *R. rotundifolio* C. B. Clarke arcte affinis, sed caulibus subteretibus (haud acute sexangulatis), indumento caulium et foliorum densiore praecipue differt.

Suffrutex perennis e basi ramosus 20–70 cm. altus. *Caules* adscendentes vel suberecti, basi lignosi glabrescentes fuscentes, supra virides firmiter herbacei rigidi subteretes indistincte longitudinaliter sulcati, pilis brevibus curvatis dense pubescentes. *Folia* late elliptica vel ovata vel obovata vel triangulari-ovata interdum suborbicularia, subsessilia vel petiolis 1–6 mm. longis instructa, lamina acuta vel obtusa interdum

emarginata vel minute apiculata basi rotundata vel subcordata raro decurrenti vel subcuneata integra vel subcrenata supra intense viridi in siccitate olivacea vel nigricanti minute subsparseque strigoso-pubescenti subtus pallidiore et praecipue ad nervos pilis plus minusve curvatis nunc subsparse nunc dense pubescenti ad subvelutina demum glabrescenti 1–4·5 (–6) cm. longa et 0·5–4 (–5) cm. lata. *Flores* sessiles vel subsessiles in paniculam terminalem 8–18 cm. longam 2–10 cm. latam more *Rhinacanthi* dispositi. *Pedunculi* teretes longitudinaliter subsulcati dense minuteque pubescentes vel pilosuli. *Bracteae bracteolaeque* minutae, pilosulae. *Calyx* profunde 5-fidus, pilis brevibus patentibus et pilis glandulosis pubescens, 5–6 mm. longus, tubo subnullo, segmentis anguste lineari-lanceolatis erectis acutis. *Corolla* alba intus in faucibus maculis dilute purpureis variegata, extus villosula et sparse glanduloso-pilosa, intus (labio postico excepto) subglabra, tubo tubuloso (17–) 22–25 mm. longo 1–1·5 mm. lato, lobis anticis obovato-ellipticis obtusis intus sparsissime praecipue ad basin glanduloso-pilosis 7–10 mm. longis 3·5–4·5 mm. latis, lobo postico lineari-oblongo acuto intus sparse glanduloso-pubescenti 6–8 mm. longo. *Genitalia* et *granula pollinis* ut in typo, stylo sparse pilosulo, ovario pilis brevibus subpatentibus et pilis glandulosis paucis dense pubescenti. *Capsula* apiculata, pilosula, 15–18 mm. longa, parte stipitata 7–9 mm. longa. *Semina* nigra, c. 3 mm. longa et lata.

Transvaal.—Soutpansberg: Messina, *Rogers* 20759, 22599; Msekwa's Poort, *Meeuse* 9188; near Mara, *Meeuse* 10198. Sebasa: near Lake Fundusi, *Bremekamp & Schweikerdt* 373. Pietersburg: Soekmekaar, *Meeuse* 9221 (PRE, holo.!, K, iso.!); Mokeetsi, *Breyer* h. No. 21450; 3 miles W. of Maliepsdrift, *Meeuse* 10644; Nelspruit: Kruger National Park, near Skukuza, *Codd* 5215, *Van der Schijff* 3407.

Portuguese East Africa.—Sul do Save: Lourenço Marques distr., Ressano Garcia, *Schlechter* 11881.

Southern Rhodesia.—Ndanga: Mtilikwe Riv., Bangara Falls, *Wild* 4361 (SRGH, PRE).

(All cited numbers in PRE, *Codd* 5215, *Meeuse* 9188, 10198, *Van der Schijff* 3407 also in K).

Straggly to suberect subshrub, branched mainly near the base, 20–70 cm. tall. *Rootstock* woody. *Stems* ascending to suberect, woody at the base and there becoming covered with a thin pale brown bark; upper parts green, firmly herbaceous to wiry, rigid, subterete, indistinctly longitudinally sulcate and densely covered with a pubescence of short, patent to more or less curved hairs. *Leaves* firmly herbaceous, varying from broadly elliptic to (ob)ovate or broadly deltoid-ovate, sometimes suborbicular, subsessile or on 1–6 mm. long shortly pubescent petioles, acute or obtuse, often minutely apiculate, occasionally emarginate; rounded, truncate to subcordate, rarely decurrent or subcuneate at the base, entire or faintly crenate, dark green drying blackish, and with a rather sparse short strigose pubescence on upper surface, paler and usually much more densely shortly pubescent to velutinous on lower surface (more densely so on the veins), rarely noticeably glabrescent, 1–4·5 (–6) cm. long and 0·5–4 (–5) cm. broad. *Flowers* sessile or subsessile in small clusters or solitary borne on a typical paniculate branched *Rhinacanthus* inflorescence 8–18 cm. long and 2–10 cm. broad. *Peduncles* and *branches of the panicles* very similar to the stems in appearance but pubescence more and more interspersed with toadstool-shaped glandular hairs as the ramifications become finer. *Bracts and bracteoles* minute, thinly covered with short stiff hairs. *Corolla* white marked with mauve in the throat, pilose outside, nearly glabrous inside except on the upper lip; the tube (18–) 22–25 mm. long and 1–1·5 mm. in diam.; anticous lip of 3 obovate-elliptic obtuse 7–9 mm. long lobes, which are very sparsely glandular-pubescent mainly near the base inside; posticous lip linear-oblong, acute, sparsely glandular-pubescent inside, 6–8 mm. long. *Pollen-grains* as in the type species. *Ovary* densely

pubescent with short stiff hairs interspersed with a few glandular hairs; style very sparsely pilose. *Capsule* apiculate, stipitate, hairy, 15–18 mm. long of which 7–9 mm. taken up by the " stalk ". *Seeds* black, orbicular in outline with a notch near the hilum, about 3 mm. in diam.

This species is very close to *R. rotundifolius* C. B. Clarke and Mr. D. J. B. Killick who compared several Transvaal specimens such as *Meeuse* 9221 (an isotype), *van der Schijff* 3407 and *Codd* 5265 with a syntype of the latter (*Thomas* 7, K) reported the following differences, which were confirmed when a specimen of *R. rotundifolius* from Kismayu, Somalia (*Bally* 9508) was received on loan from the East African Herbarium, Nairobi.

Thomas 7.	*R. xerophilus*.
1. Leaves strictly ovate (in *Bally* 9508 elliptic to oblong).	1. Leaves ovate-cordate and sometimes cordate.
2. Leaves sparsely hairy with veins prominent on lower surface.	2. Leaves densely pubescent on lower surface, veins not so prominent.
3. Stems *sharply* 6-angled in cross-section with 2–3 grooves between the angles, with very small white adpressed *retrorse* hairs, mainly on the angles.	3. Stems subterete, more undulate in cross-section without angles or intermediate grooves, abundantly hairy all round with *suberect* hairs.

These differences may seem to be small, but they are apparently constant and in this genus the differences between the species are always small, so much so that the wide-spread African species *R. gracilis* Klotzsch has for a long time been treated as identical with (and a taxonomical synonym of) the Indian *R. nasutus* (L.) Kurz (= *R. communis* Nees).

To the differences mentioned by Mr. Killick may be added that the corolla-tube in *R. rotundifolius* was described as $1\frac{1}{4}$ inch (about 30 mm.) long (in *Bally* 9508 it is 30–50 mm.) long, whereas in the plant described here the length of the corolla-tube, even in vigorous cultivated specimens, does not exceed 25 mm.; the width also differs: 1–1·5 mm. in *R. xerophilus*, 0·5–1 mm. in *Bally* 9508. Another difference between *R. xerophilus* and some related species may be found in the ecology. *R. xerophilus* seems to be restricted to open, gravelly or rocky open places in dry bushveld vegetations in areas with a low annual rainfall, classified by Acocks (Veld types of South Africa, 1953) as Arid Lowveld, Arid Sweet Bushveld and Mopani Veld, hence the specific epithet. *R. gracilis* is found in more humid situations, often in tropical lowland vegetation. The ecology of *R. rotundifolius* (recorded from Kenya, Tana River, and Somalia) is not known, but it is likely to grow in similar arid conditions as the species from Southern Africa and this may account for the great similarity in habit between these two geographically separated forms. It is possible that the two are derived from the same common ancestral form and developed independently into the present specifically different taxa, because they became geographically separated.

AMARYLLIDACEAE.

Cyrtanthus erubescens *Killick*, sp. nova distinctissima, nullis e specibus notibus propinqua.

Bulbi ad 10 cm. alti 4–6 cm. diam. *Folia* 2–4-lorata 20–60 cm. longa 2–6 cm. lata basi rubro-marginata. *Scapi* 20–50 cm. alti 1–1·5 cm. diam. *Bracteae* 2, 4-7 cm. longae 1·5–2 cm. latae. *Umbellae* 9–15-florae, pedicellis ad 5 cm. longis (fructiferis ad 7 cm.) erectis vel suberectis. *Perianthium* rubicundum 3–4 cm. 3–4 longum, tubo 8–10 mm. longo campanulato, lobis curvatis patentibus 2–3 cm. longis oblongo-lanceolatis, exterioribus 6·5 mm. latis, interioribus 6 mm. latis. *Stamina* 6, 3 in parte superiore faucium et 3 basi loborum interiorum inserta, antheris versatilibus. *Ovarium* 6 mm. longum 4–5 mm. diam. *Loculi* multiovulati. *Stigma* trifida, lobis recurvatis et marginibus leviter revolutis. *Capsulae* 2·5 cm. longae 1·7 cm. latae, seminibus compressis nitidis nigris.

NATAL.—Bergville District: locally frequent on grassy banks of stream, 9400 feet, Cathedral Peak Forest Station, *Killick* 1840; locally frequent in subalpine grassveld in moist gully below Windy Gap, c. 9300 feet, Cathedral Peak Forest Station, *Killick* and *Marais* 2187 (PRE, holotype); near upper contour path near minor stream below Inner Buttress, 6500 feet, Cathedral Peak Forest Station, *Nänni* s.n. (Nat. Herb. No. 28587).

Bulbs up to 10 cm. tall and 4–6 cm. diam., more or less gradually tapered from near base to neck, with membranous tunic. *Leaves* 2–4, developing at same time or slightly later than the inflorescence, strap-shaped, 20–60 cm. long, 2–6 cm. wide, central midrib prominent on under surface, margin red in lower third of blade. *Scape* 20–50 cm. tall, 1–1·5 cm. diam., hollow. *Bracts* 2, subtending umbel, 4–7 cm. long, 1·5–2 cm. wide, the outer appreciably larger than the inner. *Umbel* 9–15-flowered; pedicels varying in length, but rarely more that 5 cm. long (elongating to 7 cm. in fruit), erect or suberect. *Perianth* pink, 3–4 cm. long, with one of the inner perianth segments uppermost very slightly less spreading than all the others and with the style arching somewhat under it. *Tube* 8–10 mm. long, campanulate, lobes curved, spreading, 2–3 cm. long, oblong-lanceolate; outer lobes 6·5 mm. broad with small tuft of hairs within apex; inner lobes 6 mm. broad with few hairs at apex. *Stamens* 6, 3 attached to the throat of the perianth opposite the outer segments and 3 on the inner segments just below their base; anthers versatile. *Ovary* 6 mm. long, 4–5 mm. diam. *Loculi* many-ovuled, in 2 ranks. *Stigma* trifid, the lobes recurved with the margins slightly revolute. *Capsule* 2·5 cm. long, 1·7 cm. broad; seeds compressed, shiny, black.

This very attractive plant with umbels of blush-pink flowers has been found in only two places in the Drakensberg, both in the Cathedral Peak area. It was first collected in December 1952 by the author in a moist gully at 9300–9400 feet some distance below Windy Gap (Organ Pipes Pass). There it is fairly common in subalpine grassveld where it is often associated with boulders. The second station is a few miles further north below the Inner Buttress at 6500 feet. Climbers in the Drakensberg have occasionally come across the plant and have called it the " pink Agapanthus ". Its potential value as a cultivated plant has apparently been recognised, because climbers have at times made special expeditions to look for the plant.

When one uses Phillips's key to Amaryllidaceae in his Gen. S. Afr. Pl. (2nd Edition, 1951), this plant runs down to *Anoiganthus*. It agrees with Baker's original description of that genus in Journ. Bot. 76 (1878) except in two respects. Firstly, the stamens are not all inserted " at the throat of the tube "; three are situated on the inner perianth segments about 1 mm. above their base. Secondly, the flowers are pink instead of whitish or pale yellow. Neither of these characters ought to preclude this plant from *Anoiganthus*, consequently its inclusion in *Cyrtanthus* requires some explanation.

Baker in his Handb. Amaryll. ix (1888) and in Fl. Cap. 6, 171–172 (1896) distinguishes *Cyrtanthus* and *Anoiganthus* on the presence of versatile or basifixed anthers respectively. None of the specimens of *Anoiganthus* examined by the author had basifixed anthers; they were versatile. Baker himself in his original description of *Anoiganthus* describes the anthers as versatile. It is surprising, therefore, that he should use this character at all.

Phillips (l.c. p. 199) distinguished *Anoiganthus* from *Cyrtanthus* on the relative length of perianth tube to segments. In *Anoiganthus* the perianth tube is shorter than the segments and in *Cyrtanthus* the tube is much longer than the segments. The Drakensberg plant has segments which are 2–3 times longer than the tube, which would put it in *Anoiganthus*. In most species of *Cyrtanthus* the tube is longer that the segments, but in several species e.g. *C. affinis* R. A. Dyer, *C. clavatus* (L'Hérit.) R. A. Dyer, *C. bicolor*, R. A. Dyer and *C. brachyscyphus* Bak. the tube is often equal in length to the segments.

In *C. thorncroftii* C. H. Wright, the segments are as long as or longer than the tube. It seems reasonable then to enlarge our concept of *Cyrtanthus* to include plants with perianth tube shorter, equal or longer than the segments. The general facies of the Drakensberg plant is that of a *Cyrtanthus*.

Anoiganthus and *Cyrtanthus* have both been investigated cytologically. Gouws in Plant Life 5 (Herbertia Edition), 66–67 (1949) found that they have the same chromosome number, namely 2n = 16. Wilsenach (ms.) investigated *Cyrtanthus* (among other genera of Amaryllidaceae) and arrived at the same number. In a summary of his work seen by the author Wilsenach suggests that our conception of *Cyrtanthus* should be modified to include *Anoiganthus*. However, the fate of *Anoiganthus* is best left to the considered judgement of some future monographer.

COMPOSITAE.

Helichrysum milfordiae *Killick*, sp. nov. affine *H. albo* N.E. Br., sed foliis capitulisque multo minoribus, involucri bracteis apice sanguineis differt.

Herba nana pulvinata 1–3 cm. alta omnino incana. *Folia* basalia dense rosulata obovata—spathulata 0·6–1·4 cm. longa 0·49–0·9 cm. lata apice subacuta ad rotunda, folia caulina lanceolata elliptica vel spathulata apice acuminata ad rotundata saepe arista membranacea subamplexicaulia. *Scapi* 3–12 cm. alti. *Capitula* 2·5 –2·9 cm. diam. solitaria terminalia homogama. *Bracteae involucri* 4–5 seriatae lanceolatae ad ovatae acutae 0·6–1·2 cm. longae 1–4·5 mm. latae niveae saepe apice et basi sanguineae. *Receptaculum* leviter convexum et breviter alveolatum. *Styli* rami truncati. *Pappi setae* graciles apice plumosae. *Achaenia* glabra.

BASUTOLAND.—Drakensberg Area: on rocks, summit of Mount aux Sources, 9000 feet, *Thode* s.n. (Nat. Herb. No. 2749); summit of Mont aux Sources, 9500 feet, *Flanagan* 1972; rocky top of mountain in crevices between boulders, Thabana Ntlenyana, 11400 feet, *Guillarmod* 2332; in fissures of rocks on top of Thabana Ntlenyana, 11475 feet, *Coetzee* 597; fairly common on cliff faces, Castle Buttress Area, 9800 feet, *Killick* 2333.

NATAL.—Bergville District: locally abundant in cave above Organ Pipes Pass, Cathedral Peak Forest Station, 9600 feet, *Killick* 1990; forms extensive carpets in overhang at top of Organ Pipes Pass, Cathedral Peak Forest Station, 9700 feet, *Killick* 2322 (PRE, holotype); between rocks, in mats, rare, Cleft Peak, 9500 feet, *Esterhuysen* 23023.

A dwarf, cushion-forming herb, 1–3 cm. high, grey-lanate all over. *Basal leaves* densely rosulate, obovate to spathulate, 6–14 mm., 4–9 mm., apex subacute to round; cauline leaves lanceolate, elliptic or spathulate, apex acuminate to round often with a prominent membranous arista, subamplexicaul. *Scapes* 3–12 cm. tall. *Heads* 2·5–2·9 cm. diam., solitary, terminal, homogamous. *Involucral bracts* 4–5-seriate, lanceolate to ovate, acute, 6–12 mm. long, 1–4·5 mm. wide (progressively longer and narrower towards centre except for innermost row which is shorter than penultimate row), white, shiny, often crimson (occasionally brown) at apex and base. *Receptacle* convex. shallowly honeycombed, corners of pits slightly produced. *Corolla* 3·5 mm. long, filiform, glabrous except on outside of lobes. *Style* branches truncate. *Pappus* of fine bristles, plumose at apex. *Achenes* glabrous.

This new Helichrysum is an attractive carpet or cushion-forming plant consisting of scores of tightly congested grey rosettes connected by horizontal rhizomes. The cushions are found on rocks on the summit of the Drakensberg above 9000 feet. In

the Organ Pipes Pass area *H. milfordiae* usually occurs on cliffs with a southern aspect or immediately below them. Occasionally it is associated with *Crassula sp.* (Killick 2321).

H. milfordiae is closely related to *H. album* N.E. Br., but differs in the very much smaller leaves and heads, and the crimson- (sometimes brown-) tipped involucral bracts. It should be noted that the gatherings of *H. milfordiae* from the Cathedral Peak area (*Killick* 1990, 2322 and 2333, and *Esterhuysen* 23023) are consistent in having an indumentum which is lanate-floccose i.e. the hairs intertwine in a random manner, whereas in the remaining specimens the hairs are more or less straight and adpressed. At first it was thought that this might be a specific difference, but the plants agree so closely in other respects that they have here been treated as one species.

The first gatherings of this species were made in the 1890's. They were Thode s.n. in February 1893, Flanagan 1972 in January 1894 and Thode 29 in January 1896—all from Mont aux Sources. It seems that fifty years elapsed before it was collected again as a herbarium specimen; the author found it growing at the top of the Organ Pipes Pass in May, 1953. Since then the plant has been collected several times as indicated by the other specimens cited.

This plant has been cultivated in gardens in Britain for many years under the name of *Helichrysum marginatum* DC. It differs from typical *H. marginatum* in its dwarf habit (rosette plus scape up to 12 cm. high as against 25 cm.), shorter leaves (up to 1·4 cm. instead of 5 cm. long), in being lanate all over, and in having crimson-tipped involucral bracts. Interest in the plant was probably stimulated by an article by Dr. R. Seligman in Bull. Alpine. Gard. Soc. 2, 168–178 (1933) entitled " Wild Flowers of South Africa ". The part dealing with *H. milfordiae* reads: " The summit (Machache in Basutoland) and its approaches brought me three new treasures, a white *Dimorphotheca* nestling among the stones—a true scree plant if there ever was one—a tiny *Helichrysum* wedged firmly into the living stone, and in a sheltered spot a dwarf *Geranium*." Dr. Seligman included a photograph of the plant taken on the summit of Mount Machache (9300 feet).

How this species came to be grown in Britain can be gleaned from letters attached to a specimen of the plant in Kew Herbarium. The plant was sent to Kew for naming in June, 1947 by Dr. J. S. L. Gilmour, then Director of Wisley Royal Horticultural Society Gardens. Mr. A. A. Bullock dealt with the plant and decided that it was new to science, but that he would have to know more about its origin before describing it. Dr. Gilmour subsequently found out from Mr. W. E. T. Ingwersen that the plant was collected by the late Mrs. Helen A. Milford at Mont aux Sources in Basutoland and brought to England where it found its way to the gardens of alpine plant enthusiasts. The author has adopted Mr. Bullock's manuscript name of *H. milfordiae* honouring Mrs. Milford.

CONVOLVULACEAE.

Merremia guerichii *A. Meeuse*, spec. nov.,— *M. guerichiana* (Engl. ex) Hallier f. in Engl. Bot. Jb. 18: 69 (1893), nomen tantum. Ab *M. quercifoliae* Hallier f. foliis profunditer palmatilobis praecipue differt, ab *M. ampelophyllae* Hallier f. inter alia indumento setoso-piloso haud molliter pubescenti, ab *M. bipinnipartitae* (Engl.) Hallier f. indumento distinguenda.

Suffrutex. *Radix* lignosa perennis. *Caules* pauci vel plurimi, prostrati vel suberecti, 20–60 cm., interdum ad 90 cm., longi, 1·5–2·5 mm. diam., firmiter herbacei ad basin plus minusve lignosi, subtereti, sublevi vel longitudinaliter striati, pilis basi incrassatis subsparse vel subdense piloso-setosi demum glabrescentes et scabridi.

Folia firmiter herbacea in siccitate pergamacea, lamina ambitu ovato-orbicularia profunde 3–5 palmatifida glabra vel ad nervos sparse setosa 1–5 cm. longa et lata, lobis lyratis vel pinnatifidis vel crasse acuteque dentatis, petiolis setosis 0·5–3 cm. longis. *Inflorescentiae* 1–2-florae, pedunculis satis gracilibus subteretibus sparse setosis 0·5–4 cm. longis, bracteolae minutae, pedicellis 0·5–2 cm. longis. *Calyx* viridis in parte inferiora subdense pilis basi incrassatis setosus, lobis erectis oblongis vel anguste ellipticis vel cuneato-oblongis acutis vel subobtusis frequenter minute apiculatis subaequalibus 12–18 mm. longis. *Corolla* infundibuliformis, alba vel flavescens, vinoso-oculata, glabra, 5-lobata, 2·5–3·5 cm. longa lataque, lobis obtusis interdum minute apiculatis. *Stamina* subaequalia ad basin dilata et pilis minutis rectis papilloso-puberula, pollen *Merremiae*. *Ovarium* subglobosum, glabrum. *Capsula* subglobosa, straminea, apiculata, glabra, c. 12 mm. diam. *Semina* atrogrisea vel fusca, puberula, c. 8 mm. longa.

South West Africa.—Kaokoveld: between Orupembe Waterhole and Kunene River, *de Winter & Leistner* 5741 (PRE, holo.! EA, K, M, SRGH, isos.!); Anabib (Orupembe), *Story* 5698; without precise locality: *Von Koehnen* s.n. (M). Omaruru: Brandberg, Tsisab Gorge: *R. & F. von Wettstein* s.n. (M), *Rhodes University Student* s.n. (PRE), *Merxmüller & Giess* 1654 (M, PRE).

Perennial suffrutex. *Stems* several from a woody rootstock, rather firm to wiry, young stems often erect, older ones often prostrate; young parts rather densely setose-pilose with patent bulbous-based stiff hairs; older parts glabrescent and becoming scabrid, usually more or less woody, ultimate length about 60 cm., occasionally up to 90 cm., width near the base 1·5–2·5 mm.; internodes on prostrate stems up to about 7 cm. long but usually shorter (2–5 cm.). *Leaves* firmly herbaceous drying pergamaceous; the lamina in outline ovate-orbicular, deeply 3–5-palmatifid, usually nearly glabrous with only a few setose hairs on midrib and main veins towards the base, 1–5 cm. long and broad; the lobes lyrate to pinnatifid or coarsely and acutely, usually more or less coarsely, dentate; the petiole setose, 0·5–3 cm. long. *Flowers* solitary or in 2-flowered cymes; peduncles rather slender but firm, nearly terete, sparsely setose, 0·5–4 cm. long; bracteoles minute; pedicels 0·5–2 cm. long. *Calyx* green, in basal portion rather densely setose or even bristly with stiff bulbous-based patent hairs; sepals subequal, erect, oblong, narrowly elliptic or cuneate-oblong, acute or subobtuse and usually minutely apiculate, 12–18 mm. long; in fruit turning brown, slightly enlarged (mostly in width) and glabrescent becoming somewhat scabrid in lower portion. *Corolla* funnel-shaped, white or pale yellow with wine-coloured or maroon "eye", glabrous, 2·5–3·5 cm. long and as much in diam., with a 5-lobed spreading limb, lobes of limb obtuse, occasionally minutely apiculate. *Stamens* subequal, at the laterally broadened base with papillose short stiff straight hairs. *Pollen grains* typical of the genus. *Ovary* subglobose, glabrous. *Capsule* subglobose, apiculate, straw-coloured, glabrous, about 12 mm. in diam. *Seeds* dark grey or brownish grey, puberulous, about 8 mm. long.

This plant has been collected on several occasions but seems to be restricted to a comparatively small area including a part of the Kaokoveld and the area of the Brandberg (Omaruru district) in South West Africa. It was most probably collected by Guerich for the first time about 70 years ago, but his specimen (in Berlin) was destroyed and it was never properly described, so that the evidence that "*Merremia guerichiana*" is the same plant as the one described here as "*guerichii*" is circumstantial: (1) *Guerich* 69 was collected at Soris-Soris, which is not far from the Brandberg, and (2) a second specimen was cited under *M. guerichiana* by Hallier, viz., *Fischer* 34 from East Africa. This caused some confusion when Dr. B. Verdcourt of Nairobi studied *Fischer* 34 a few years ago and decided it is *M. ampelophylla*. As he did not see the Guerich gathering he took it for granted that the two specimens cited by Hallier were indeed identical,

so that in a remark in Kew Bull. 1957: 348 Dr. Verdcourt stated that *M. ampelophylla* occurs both in East Africa and in South West Africa. The South West African plant is undoubtedly specifically different from *M. ampelophylla*, but is closely related to it, so that it is not surprising that one could confuse the species described here with the East African one. It follows that *Guerich* 69 must have been conspecific with *M. guerichii*, otherwise Hallier could not have cited it together with *Fischer* 34. Dr. Verdcourt has seen a specimen of *M. guerichii* and agrees that it is distinct from *M. ampelophylla*.

The identity of *M. guerichiana* seems, therefore, to be definitely established. (1) However, the specific epithet "*guerichii*" was chosen which conveys the same but is not nomenclaturally synonymous, so as to avoid the dangerous action of validating a name without access to the original type (*Guerich* 69). In this way a new gathering could be chosen as the type of *M. guerichii*, a solution which is much more satisfactory and not at variance with certain recommendations in the Code of Botanical Nomenclature.

GRAMINEAE.

Andropogon ravus J. G. Anderson, sp. nov., *A. sylvatico* C. E. Hubbard affinis, sed ita differt: habitu brevior, cum rhizomatibus, culmi 2–3-nodosi glabri, vaginae quam internodia breviores, spiculae pedicellatae longiores, glumae spicularum pedicellatarum et glumae superiores spicularum sessilium sine aristis.

Gramen perenne ad 90 cm. altum (plerumque 45–60 cm.) rhizomatibus ramosis. *Culmi* erecti simplices 2–3-nodosi glabri obscure striati vel leves teretes, nodis glabris, internodiis exsertis glabris levibus. *Folia* ad 23 cm. longa 3–6 cm. lata plana linearia. *Vaginae* glabrae internodiis breviores, lamina summa saepe ad aristam brevem redacta, ligula membranacea ad 2 cm. longa. *Racemi* 7–12 cm. longi, spiculis pallidi-viridibus purpura suffusis. *Spiculae sessiles* lineari-oblongae 6–9 mm. longae callo obtuso barbato. *Glumae* subaequales, inferior canale profunde per mediam fundum, tenuiter coriacea apicem versus admodum carinata carina anguste alata in dimidio superiore scabrida vel ciliata, superior naviformis triente superiore carina scabrida vel ciliata marginibus leviter ciliatis subacuta 1–3-nervata. *Lemma floris inferioris* 6–8 mm. longum 2-carinatum obtusum 3-nervatum marginibus acute inflexis hyalinis et in dimidio superiore ciliatis. *Palea* non nervosa hyalina 2–3 mm. longa *Lemma floris superioris* 5–6 mm longum inter lobos acutos aristatum arista ad 2 cm. longa infra genu contorta *Palea* nulla. *Spicula pedicellata* dorsaliter compressa. *Glumae* inaequales, inferior 7–12 mm longa plana carinata carinis et marginibus ciliis hyalinis rigidis apice mucronato vel obtuso, superior breviter naviformis 6–9 mm. longa 3-nervata vel obscure 5-nervata marginibus cilatis apice acuto. *Flos inferior* sterilis lemmate 7–8 mm. longo marginibus inflexis in dimidio superiore obscure ciliato hyalino obtuso 3-nervato palea non nervosa hyalina. *Flos superior* masculinus, lemmate 6 mm. longo apice obtuso marginibus inflexis palea nulla. *Antherae* lineares 4-5 mm. longae.

Cape Province.—Maclear District: near lower Pitsing, sandy banks of Lusio River, locally frequent, c. 4,700 feet, *Acocks* 12191.

Natal.—Bergville District: Cathedral Peak, towards Indumeni, Cleft Peak, c. 7,000 feet, *J. M. Gomell;* occasional in *Themeda triandra* Grassveld c. 6,700 feet, *Killick* 1261 (PRE, holotype).

(1) Note added in proof: Dr. S. J. van Ooststroom of the Rijksherbarium, Leiden, kindly sent me the notes on *M. guerichiana* which he found among the unpublished manuscripts left by Hallier. These notes include a detailed description which agrees perfectly with the plants cited above (bulbous-based hairs on vegetative parts and calyx, and similar details) and Hallier mentions only *Guerich* 69 (herb. Berol.). This is the decisive evidence for the identity of "*M. guerichiana*" with the plants described here as *M. guerichii*.

ORANGE FREE STATE.—Bethlehem District: Golden Gate, c. 6,000–7,500 feet, *Story* 1957.

SWAZILAND.—Mbabane: Ukutula, c. 4,300 feet, *Compton* 25593.

Perennial, up to 90 cm. tall, usually 45–60 cm., with a branched knotty system of rhizomes. *Culms* erect, simple, 2–3-noded, glabrous, faintly striate or smooth, terete; nodes glabrous; internodes exserted, glabrous and smooth. *Leaves* up to 23 cm. long, 3–6 mm. wide, flat, linear, tapering to a setaceous point, narrowed towards the base or base slightly rounded, glabrous, glaucous, margins often scabrid; sheaths glabrous, striate, pallid or upper often suffused with purple, shorter than the internodes, leaf blade of uppermost sheath often reduced to a short awn, mouth often with a few long hairs; ligule membranous, scarious, up to 2 mm. long. *Inflorescence* of 2 (very occasionally 3) spikelike racemes, shortly pedicelled or lowermost sessile. *Racemes* 7–12 cm. long; spikelets light green suffused with dull purple, paired, lower sessile, upper pedicelled. *Sessile spikelets* linear-oblong, 6–9 mm. long; callus obtuse, bearded. *Glumes* sub-equal, lower with a deep median groove, thinly coriaceous, strongly keeled upwards, mucronate, keel narrowly winged, scabrid to ciliate in the upper half; upper boat-shaped, with a scabrid or ciliate keel in the upper third, finely ciliate on the margins, subacute, 1–3-nerved. *Lemma* of the lower floret 6–8 mm. long, 2-keeled with sharply inflexed margins; margins ciliate in the upper half, hyaline, obtuse, 3-nerved. *Palea* a nerveless hyaline scale 2–3 mm. long. *Lemma* of upper floret 5–6 mm. long, awned from between the acute lobes; awn up to 2 cm. long, twisted below the knee. *Palea* absent. *Pedicelled spikelet* dorsally compressed. *Glumes* unequal; lower 7–12 mm. long, keeled, keels and margins with stiff hyaline cilia, apex mucronate or obtuse; upper shallowly boat-shaped, 6–9 mm. long, 3– or faintly 5-nerved, margins ciliate, apex acute. *Lower floret* sterile. *Lemma* 7–8 mm. long, margins inflexed, sparsely ciliate in upper half, hyaline, obtuse, 3-nerved. *Palea* a nerveless hyaline scale. *Upper floret* male. *Lemma* 6 mm. long, apex obtuse, margins inflexed. *Palea* absent. *Anthers* linear, 4–5 mm. long.

Andropogon ravus is occasional in *Themeda triandra* grassveld on mountain slopes near Mbabane in Swaziland and in the foothills of the Drakensberg from Bethlehem in the Orange Free State to Maclear in the Cape Province. In the Bergville and Estcourt districts it occurs on the terrace immediately below the main Drakensberg escarpment between 6,000 and 7,000 feet. According to Mr. D. J. B. Killick, who has analysed the sourveld in the Cathedral Peak area, **A.** *ravus* provides 0·75 per cent to 0·95 per cent of the basal cover in a total grass cover of between 40 per cent and 47 per cent. He also states that it is readily recognised in the field, even when not in flower, because of its glaucous-grey colour.

This grass is closely allied to *A. sylvaticus* C. E. Hubbard described from Nyasaland. Our material was compared with this at Kew. The main differences are as follows:

A. sylvaticus is a tufted perennial 1–1·3 m. high with the leaf-sheaths longer than the internodes and the upper sheaths pilose with lax soft hairs, whereas *A. ravus* has a system of branched knotty rhizomes, is generally shorter and rarely up to 90 cm. tall and the glabrous leaf-sheaths are shorter than the internodes.

In *A. ravus* the pedicelled spikelets are longer and up to 12 mm. long compared with those of *A. sylvaticus* which are 7–8 mm. long. The apex of both the upper and lower glumes of the pedicelled spikelet of *A. sylvaticus* is aristate whereas the upper glume in *A. ravus* is acute and the lower mucronate or obtuse. The apex of the upper glume of the sessile spikelet in *A. sylvaticus* is aristate at the apex and subacute in *A. ravus*.

The awn of the lemma of the upper floret of the sessile spikelet is up to 2·0 cm. long in *A. ravus* and only up to 1·5 cm. long in *A. sylvaticus*.

Danthonia stereophylla J. G. Anderson, sp. nov., *D. drakensbergensi* affinis, sed ita differt: folia rigidissima inflorescentiae aequalia vel inflorescentiam superantia, appendices laterales lemmatis angustiores, aristae loborum lemmatis longiores.

Gramen perenne caespitosum ad 80 cm. altum. *Culmi* erecti simplices compressi obscure nodosi glabri leves. *Folia* rigidissima subpungentia glabra levia inflorescentiae aequalia vel inflorescentiam superantia, vagina rigida pallida striata intus pubescente, inferiore indurata, ligula ad seriem densam ciliarum brevium redacta, laminis filiformibus rigidis ad 36 cm. longis conduplicatis supra striatis minute scaberulis, supra ligulam sericeo-pubescentibus marginibus integris. *Paniculae* erectae laxe contractae angustae lanceolatae ad 18 cm. longae, rhachide subangulata striata glabra levi, ramulis subteretibus leviter patentibus solitaribus in axillaribus sericeis, pedicellis 3–20 mm. longis angulatis vel subteretibus glabris nonnunquam scaberulis. *Spiculae* ad 2 cm. longae pallidi-flavae nitidae. *Glumae* lanceolatae, 1·1–1·8 cm. longae subaequales pallidae nitidae glabrae leves, superiores marginibus basin versus saepe pubescentes, 1-nervosae carinatae acutae. *Rhachillae internodii* glabri apicem versus ampliati complanati. *Lemmata* lanceolata ad 16 mm. longa bilobata, supra glabra, intus sparse pilosa, marginibus media sub parte pilosa, apicem versus sparse pilosa pilis non caespitosis, lobis ad 9 mm. longis margines versus tenuiter scabris acuminatis in aristam gracilem scabram productis. *Callus* truncatus dense barbatus. *Arista media* geniculata ad 2 cm. longa scaberula, apicem versus angustior basin versus complanata et spiraliter contorta non lobis adnata. *Paleae* ad 7 cm. longae intus pubescentes apice bilobatae distincte carinatae carinis et lobis breviter ciliatis lobis ad 2 cm. longis. *Antherae* circiter 3 mm. longae. *Ovarium* glabrum stylis distinctis.

BASUTOLAND.—Drakensberg Area: often dominant on rock outcrops on summit of Drakensberg between Indumeni Dome and Cleft Peak, 9,800 feet, *Killick* 2349; common on rock outcrops on summit of Drakensberg in Cleft Peak Area, c. 9,800 feet, *Killick & Marais* 2183.

NATAL.—Estcourt District: edge of south krantzes, frequent, Tabamhlope, c. 6,400, *Acocks* 11472; summit and elsewhere common, Bushman's Pass, 7,100–9,000 feet, *West* 1690; occasional on slopes of Drakensberg near Champagne Castle, 10,000 feet, *West* 799. Bergville District: Tutumi Valley, 9,000 feet, *Killick* 2339; Cathedral Peak Forestry Station, 6,300 feet, *Killick* 1317; 7,400 feet, *Killick* 1184 (PRE, holotype).

A rigid, wiry, tufted, perennial. *Culms* erect, simple, up to 80 cm. high, compressed, obscurely noded, glabrous and smooth. *Leaves* very rigid, subpungent, glabrous, smooth, reaching up to or overtopping the inflorescence; sheaths rigid, pale, striate above and minutely scaberulous, sericeous above the ligule, margins entire. *Panicle* erect, loosely contracted, narrowly lanceolate, up to 18 cm. long; rhachis sub-angular, striate, glabrous and smooth; branches sub-terete, slightly spreading, solitary or apparently binate, lower up to 7 cm. long, upper shorter, sericeous in the axis; pedicels 3–20 mm. long, angular or subterete, glabrous, occasionally scaberulous. *Spikelets* up to 2·0 cm. long, pale yellow-green, shiny. *Glumes* lanceolate, 1·1–1·8 cm. long, sub-equal, pale, shiny, glabrous and smooth, upper glume often with a few long hairs on the margin towards the base, 1-nerved, carinate, acute. *Rhachilla internodes* glabrous, broadened towards the apex and flattened. *Lemmas* lanceolate, bilobed, up to 16 mm. long (including the lobes) glabrous dorsally, sparsely hairy on the inside, pilose near the margin from about the middle downwards, sparsely pubescent on the margin upwards, hairs usually not arranged in distinct tufts; lobes up to 9 mm. long, finely scaberulous towards the margin, acuminate and gradually tapering into a scaberulous, slender awn. *Callus* truncate, densely barbate. *Central awn* geniculate, up to 2 cm. long, scaberulous, tapering towards the apex, flattened towards the base and spirally contorted, not adnate to the lobes. *Palea* up to 7 mm. long, pubescent on the inside, apex 2-lobed, distinctly keeled; keels and lobes shortly ciliate, lobes up to 2 mm. long. *Anthers* about 3 mm. long. *Ovary* glabrous; styles distinct.

Danthonia stereophylla is closely related to *D. drakensbergensis* Schweick. The distribution of these two species in the Drakensberg overlaps, but they can be distinguished on both ecological and morphological grounds.

D. stereophylla occurs on the Little Berg and its outliers (e.g. Tabamhlope), and on the main Drakensberg escarpment from 6,000 feet to the summit at c. 11,000 feet. So far it has only been collected between Bushman's Pass (Langalibalele's Pass) and Cleft Peak, but it has been recorded further north at Mont Aux Sources by Mr. D. J. B. Killick. At its lower altitudinal limits it grows on outcrops at the edge of koppies, and in the alpine zone it is often dominant on dry basalt cliffs and horizontal pavements. Its habitat is essentially xeric. *D. drakensbergensis* is restricted to the sub-alpine and alpine zones above 8,000 feet and, in contrast to *D. stereophylla* it occupies mesic situations on streambanks and seepage areas.

Vegetatively, the plants can be distinguished quite easily in the field. *D. stereophylla* is a wiry plant up to 80 cm. tall with rigid, erect or suberect, grey-green leaves, whereas *D. drakensbergensis* is a taller plant (up to 100 cm. high) with softer, olive-green leaves. A peculiar feature of *D. drakensbergensis* (also of *D. macowanii Stapf*) which is not evident in *D. stereophylla* concerns the behaviour of old leaves; the leaves break off a little distance above the ligule and the portion remaining splits along the middle nerve and the resultant halves recurve outwards at the apex.

The main differences in the spikelet are:

The hairs of the lemmas of *D. drakensbergensis* are arranged in 3 distinct tufts on each side, arranged in an oblique row at about the middle while the margin of the lemma is glabrous downwards. In *D. stereophylla* the hairs are arranged in a more or less continuous band along the margin, with long soft hairs from the base to the middle, and short rather sparse hairs from the middle to the apex. There is usually no definite formation of tufts, but the hairs at the middle occasionally aggregate to form a single tuft.

In *D. drakensbergensis* the lobes of the lemmas are broad, and taper rather abruptly into the awns. In *D. stereophylla*, however, the lobes are narrow and taper very gradually into the long slender awns, so that it is impossible to say where the lobes end and the awns begin.

The lemmas (lobes plus awn) of *D. stereophylla* are 10–16 mm. long and up to 10 mm. in *D. drakensbergensis*. Schweickerdt in his description of *D. drakensbergensis* in Fedde Rep. XLIII, 88 (1938) gives the length of the lemmas as up to 14 mm., but it is possible that his range of material included specimens of *D. stereophylla*.

Panicum volutans *J. G. Anderson*, sp. nov., affine *P. obscuranti* (Woodrow) Stapf, sed nodis hirsutis, spiculis glumis et lemmatibus floris inferioris longioribus multo acuminatioribus, gluma inferiore manifesto 3-nervata differt.

Gramen annuum. *Culmi* erecti basi geniculati nodis hirsutis. *Folia* hispida pilis e tuberculis minutis ortis praesertim superne; vaginae externe pilis e tuberculis minutis ortis. *Paniculae* 40 cm. longae 25 cm. latae effuse ramosae. *Spiculae* 6·0–6·5 mm. (raro 5·5 vel 7·0 mm.) longae. *Gluma* inferior 4·5–5·0 mm. longa, longo-acuminata manifesto 3-nervata, nervo uno secundaris divergente ab nervorum exteriorum, nervis primariis scaberulis; superior 6 mm. longa longo-acuminata manifesto 7–9 nervata nervis scaberulis. *Lemma floris inferioris* 4·0–4·5 mm. longum longo-acuminatum 7-nervatum. *Antherae* 1·5 mm. longae.

Cape Province.—Vryburg District: Armoedsvlakte, c. 3,960 feet, *Mogg* 8108.

Natal.—Estcourt District: Moordspruit, 8 miles north of Estcourt, c. 3,500 feet, *Codd* 2466; Moordspruit near Estcourt c. 3,500 feet. *Acocks* 9947.

Transvaal.—Rustenburg District: 35 m. north of Swartruggens, c. 3,900 feet, *Acocks* 19179. Pretoria District: Onderstepoort, *Theiler* 27137; *Leendertz* 11335; Wonderboom Poort, *Mogg* 9937; Boschkop, 20 m. east of Pretoria, along banks of small river, *Kinges* 1721; Koedoespoort, *Pole-Evans* 327; Middelkop Farm near Pienaars River, *Smith* 2169; Rissik, c. 4,500 feet, *Robinson* sn.; Onderstepoort, c. 4,300 feet, *du Toit* 14; *Franks* 10616. Ermelo District: Between Bethal and Ermelo, *Codd* and *Muller* 268. Naboomspruit District: Vogelstruispan, *Galpin* M. 548. Standerton District: Teakworth, *Stent* sn.; New Denmark, *Marais* 16. Waterberg District: Bingley, Kopje Alleen, *Lyall Soutter* sn. Warmbaths District: Crecy, *Barenbrug* 1. Ventersdorp District: abundant in cultivated lands in vlei, *Louw* 1713 (PRE, holotype).

A loosely tufted annual. *Culms* up to 75 cm. tall, often sparingly branched, erect from a geniculate base, often rooting at the lower nodes; internodes terete, glabrous, smooth or faintly striate, easily compressible, lower often tinged with purple; nodes hirsute. *Leaves* up to 23 cm. long and 1 mm. broad, linear, tapering to a sub-setaceous apex, hispid with bulbous-based hairs on both surfaces, the upper more hairy than the lower, margins scabrid; ligule a membranous long-ciliate rim; sheath striate, outer surface hispid with bulbous-based hairs, inner surface glabrous, usually tinged with purple. *Panicle* large, up to 40 cm. long and 25 cm. broad, profusely branched, branches with 1–3 spikelets at their apex, naked below, lowest primary branches whorled, base often enclosed in the uppermost sheath; rhachis angular, grooved, scaberulous on the angles, often tinged with purple. *Spikelets* 6·0–6·4 mm. (rarely 5·5–7·0 mm.) long, borne singly at the tips of long pedicels, lanceolate, acuminate, green, usually tinged with purple. *Glumes* unequal; lower 4·5–5.0 mm. long, long acuminate, membranous, prominently 3-nerved with 1 secondary nerve diverging from each of the outer primary nerves, primary nerves scaberulous; upper 6·0 mm. long, long acuminate, membranous, prominently 7–9 nerved with the nerves scaberulous. *Lower* floret barren. *Lemma* 4·0–4·5 mm. long, long acuminate, membranous, 7-nerved. *Palea* 2·0 mm. long, elliptic-oblong, hyaline. *Upper floret* bisexual. *Lemma* 2·75 mm. long, crustaceous, hard, smooth, narrowly oblong, apex obtuse, faintly 5-nerved, yellowish-grey with the nerves showing up as light-coloured lines. *Palea* 2·75 mm. long, narrowly oblong, apex obtuse. *Anthers* 1·5 mm. long.

Panicum volutans is found mainly in black turf soil in cultivated and other disturbed areas. It is one of the grasses known as " Rolling grass " or " Tumble Weed ", an allusion to the panicle which breaks off as a unit when mature and is carried away by the wind.

It is closely related to the Indian grass *P. obscurans* to which it was formerly erroneously referred. However, Mr. B. de Winter, found at Kew in 1952, that the South African plant is specifically distinct. Another close relative is *P. hippothrix* K. Schum. a tropical African species which is doubtfully distinct from *P. obscurans* (Woodrow) Stapf. Stapf in Flora of Tropical Africa 9, 699 (1902) says that *P. hippothrix* is " very similar and possibly identical with *P. obscurans* from the Deccan, but the blades of *P. obscurans* are much wider (up to 7 lin) and the panicle is perhaps on the whole more open with slightly larger spikelets ". Mr. de Winter supports the view that these species are probably synonymous since he could find no significant difference when dissecting spikelets of both at Kew.

Chippindall in the " Grasses and Pastures of South Africa " 328 (1955) refers to it as *Panicum* sp. aff. *P. hippothrix* K. Schum. because a valid name was not available at the time.

P. volutans differs from *P. obscurans* as follows: In *P. obscurans* the spikelets are about 4 mm. long with the lower glume approximately 3 mm. and the upper approximately 4 mm. long. In *P. volutans* the spikelets are about 6 mm. (rarely 5·5–7.0 mm.)

long with the lower glume 4·5–5·0 mm. and the upper glume 6·0 mm. long. The glumes and the lemma of the lower floret are much more acuminate than in *P. obscurans*. The nervation of the lower glume and the fertile floret is also different. In *P. obscurans* the lower glume is prominently 5-nerved, whereas in *P. volutans* it is prominently 3-nerved with a faint secondary nerve diverging on each side of the outer primary nerve. The fertile floret tends to turn brown in colour with the nerves showing up as light coloured lines. This is not the case in *P. obscurans*. Vegetatively there is very little difference between the two species except that the nodes are glabrous in *P. obscurans* and loosely to densely hirsute in *P. volutans*. The panicle is perhaps more rigidly branched than that of *P. obscurans*.

TILIACEAE.

Corchorus confusus *Wild*, sp. nov.; affinis *C. triloculari* L. sed habitu perenni, a *C. asplenifolio* Burch. sed pedunculo fructuoso recto foliis anguste lanceolatis vel ovatis, ramulis omnibus partibus patenti-pilosis, a *C. angolensi* sed petiolis distincte brevioribus et indumento differt.

C. serraefolius var. *lancifolius* Szyszyl., Polyp. Thalam. Rehmann.: 61 (1887) pro parte quoad specim. *Rehmann* 4200 (BM; K) *nomen nudum*. *C. triloculares* sensu Burtt Davy, Man. Fl. Pl. Ferns Transv. & Swazil. 1: 257 (1926) pro parte excl. specim. *Thorncroft* 2058 et *Nelson* 381. Non *C. triloculares* L.

Herba perennis, radice lignosa, ramulis annuis ad 0·6 m. longis subprostratis vel erectis omnibus partibus saltem juvenilibus patenti-pilosis. *Folia* petiolata, petiolo ad 8 mm. longo omnibus partibus patenti-pilosis; lamina ad 7 × 2·6 cm., anguste lanceolata vel ovata, utrinque praesertim nervis pilosa, apice acuta vel obtusa, basi rotundata vel leviter cordata ecaudata vel aliquando caudata c. 2 mm. longa, margine crenata vel crenato-serrata, nervis basalibus 3–5 valde arcuato-adscendentibus, nervis lateralibus utrinsecus 6–12, nervis omnibus supra leviter prominulis, subtus prominantitibus; stipulae ad 6 mm. longae, setaceae, sparse pilosae. *Inflorescentia* axillaris; cymae pro nodo unicae, oppositifoliae, (1) 2–3-florae; pedunculi 0·4–2·5 cm. longi, omnibus partibus pilosis; pedicelli pedunculis similes, ad 0·8 cm. longi; bracteae ad 6 mm. longae, setaceae, sparse pilosae. *Alabastra* ovoidea demum oblongo-ovoidea, plerumque apiculata. *Sepala* ad 1 × 0·15 cm., lineari-lanceolata vel anguste lanceolata, apice caudato-acuminata, extus pilosa. *Petala* flava, quam sepalis paullo breviores, oblanceolata vel obovata, basi breviter unguiculata ciliata. *Androgynophorum* c. 0·5 mm. altum ad apicem annulo glabro leviter undulato instructum. *Stamina* c. 50, filamentosa. *Ovarium* 3-loculare, trigono-cylindricum, dense pubescens; stylus c. 2·5 mm. longus, tenuis, glaber. *Capsula* c. 3 × 0·2 cm., subcylindrica, pedunculo fructuoso recto, apice obtusa, sparsissime scabroso-pilosa demum glabrescens; seminibus numerosis c. 2 × 1·2 mm. intense brunneo-griseis.

Cape Province.—Griqualand East, Umzimkulu R., fl. & fr. xii. 1884, *Tyson* 1413 (K; PRE).

Natal.—Zululand, Egoa Farm, fl. & fr. i. 1922, *Curson* s.n. (PRE); Hlabisa, fl. 10.iv.1954, *Ward* 2306 (PRE). Fort Yolland, fl. & fr. 19.iii. 1903, *Medley Wood* 8976 (PRE). Estcourt, fl. & fr. 15.xii.1937, *West* 527 (PRE).

Transvaal.—Barberton, fl. & fr. ix–xii.1889, *Galpin* 577 (K; PRE). Johannesburg, fl. xi.1902, *Rand* 1061 (BM). Shiluvane, fl. iii–v.1905, *Junod* in Herb. Transv. Mus. 4895 (PRE). Lydenburg, Waterval Boven, fl. & fr. 20.xii.1914, *Rogers* 10933 (PRE). Pretoria, Aapies Poort, fl. & fr. 1875–1880, *Rehmann* 4200 (BM; K); Pretoria, fl. 6.xii.1919, *Verdoorn* 69 (PRE). Rietvlei Reserve, fl. & fr. xi.1946, *Repton* 3170 (PRE). Kruger National Park, 5 m. N. of Pretorius Kop, fl. & fr. 4.ii.1949, *Codd & de Winter* 4960 (K, holo.; PRE).

SWAZILAND.—Without precise locality, fl. vi.1910, *Stewart* in Herb. Transv. Mus. 8999 (PRE).

MOZAMBIQUE.—Lourenço Marques, Incanhini, fl. & fr. 13.i.1898, *Schlechter* 12024 (K). Umbeluzi, fl. & fr. 27.x.1952, *Myre & Carvalho* 1283 (LM; K).

SOUTHERN RHODESIA.—Gwelo District: 15.iv.1905, *Gardner* 40 (K). Gwanda District, fl. 17.xii.1956, *Davies* 2386 (K; SRGH).

This species has been frequently confused in the past with *C. asplenifolius*; superficially there is a resemblance but the straight fruiting peduncles and stems hairy on all sides render it easy of recognition as a rule. In addition there is on the whole a difference in leaf-shape and the fruits are always quite straight; in *C. asplenifolius* they are typically slightly falcate. Burtt Davy (loc. cit.) included this taxon under *C. trilocularis* but our plant is an indigenous perennial and cannot be conspecific with the annual weed *C. trilocularis*, which is distributed throughout the tropics and subtropics of the Old World. Our plant is also very near *C. angolensis* but the latter species has markedly longer, more slender petioles and acuminate, ovate-lanceolate leaves: it is also more nearly glabrous and although quite closely related it has a noticeably different facies.

Corchorus merxmuelleri Wild, sp. nov.; *C. angolensi* Exell & Mendonça affinis sed foliis ovatis utrinque dense stellato-tomentellis.

Suffrutex c. 2 m. altus ramis numerosis late patulis griseo-tomentellis demum glabrescentibus, cortice brunneo. *Folia* petiolata, petiolo ad 6 mm. longo, utrinque griseo-tomentello; lamina ad 2·2 × 1·6 cm., ovata, apice acuta, basi leviter cordata, margine valde serrato-dentata, utrinque griseo-tomentella, nervis lateralibus utrinsecus 4, supra inconspicuis, subtus prominentibus; stipulae ad 2 mm. longae, subulatae, griseo-tomentellae. *Inflorescentia* axillaris, cymae pro nodo unicae, oppositifoliae, 1–2-florae; pedunculi ad 2 mm. longi, griseo-tomentelli; pedicelli ad 5 mm. longi, griseo-tomentelli; bracteae 1·5 mm. longae, subulatae, griseo-tomentellae. *Sepala* 5–6 × 0·75–1·0 mm., anguste oblanceolata, apice longe acuminata, dorso leviter carinata, extus griseo-tomentella, intus glabra. *Petala* flava, 9 × 4·5 mm., anguste obovata, basi breviter unguiculata margine minute ciliata. *Androgynophorum* c. 0·5 mm. altum. *Stamina* c. 60, filamentosa. *Ovarium* 3-loculare, trigono-cylindricum, brevissime tomentellum; stylus 4 mm. longus, glaber. *Capsula* 3–4·5 × 0·15 cm., subcylindrica, leviter torulosa, obtuse 2 mm. rostrata, griseo-tomentella demum sparse stellato-puberula, pedunculis maturitate rectibus; seminibus numerosis brunneis c. 2 × 1 mm. subcylindricis.

SOUTH WEST AFRICA.—Karibib, Erongogebirge, fr. 17.ii.1953, *H. Kinges* 3257 (M): bush. Omaruru, Otjihorongo Reserve, N. sides of porphyritic koppies on the Ugab E. of Rooipoort, fl. & fr. 15.ii.1958, *H. Merxmüller & W. Giess* 1620 (M, type): bush 2 m. tall, 3 m. wide.

This species is similar in habit to and is related to *C. angolensis* Exell & Mendonça but its small ovate tomentellous leaves give it a very distinctive appearance. It is an unusually large plant for a *Corchorus* species.

Corchorus pinnatipartitus Wild, sp. nov.; *C. asplenifolio* Burch. affinis sed foliis profunde pinnatipartitis.

Herba perennis, radice lignosa, ramulis annuis usque ad 20 cm. longis suberectis vel prostratis glabris sed lineis pilis crispis munitis. *Folia* petiolata, petiolo ad 7 mm. longo, parte adaxiali pilosa, parte abaxiali glabra; lamina ad 2·5 × 1·2 cm., ambitu anguste oblonga sed profunde pinnatipartita usque ad $\frac{4}{5}$ lobata, aliquando ad basin

leviter palmatipartita, lobis versus folii basin majoribus obtusis vel subacutis simplicibus raro laterale 1-dentatis, apice obtusa vel subacuta, basi truncata vel leviter cordata ecaudata, utrinque minute punctulata, utrinque glabra vel costa subtus minute sparse puberula; stipulae 2 mm. longae, lanceolatae, apicibus subulatis. *Inflorescentia* axillaris; cymae pro nodo unicae, oppositifoliae, 1–3-florae; pedunculi c. 1 mm. longi vel nulli; pedicelli ad 1 cm. longi, tenues, puberuli; bracteae c. 1 mm. longae, setaceae. *Sepala* plerumque purpurina, c. 7 mm. longa, oblanceolata, apice subacuta vel acuta, glabra. *Petala* flava vel plerumque roseo-purpurea suffusa, c. 7 mm. longa, anguste obovata, basi breviter unguiculata minute ciliata. *Androgynophorum* c. 0·25 mm. altum. *Stamina* numerosa, filamentosa. *Ovarium* 3-loculare, ellipsoideum, aliquantum trigonum, minutissime glanduloso-papillosum; stylus 3 mm. longus, glaber. *Capsula* c. 2 × 0·2 cm., subcylindrica, apice obtusa, sparse glandulosa, pedunculis plerumque contortis; seminibus numerosis fuscis 1·5 × 1 mm. subcylindricis angulatis.

Cape Province.—Hay Division, Wilde-als Put, 16 miles East of Griquatown, frequent on red sand over limestone, fl. & fr. ii.1937, *Wilman* 4075 (K; KMG). Barkly West Division, Silverstreams, fl., 15.iii.1939, *Esterhuysen* 776 (BOL; K). Kuruman Division, Kuruman, limestone, Edmonstone-Sammons 54 (KMG); Cardington, common on surface limestone, fl. iv.i.1940, *Ferrar* s.n. (K; KMG); Cotton End, fl. & fr., iv.1940, *Ferrar* s.n. (K); Cardington, fl. & fr. iv.1940, *Esterhuysen* 2188 (K, type; BOL; PRE) Cotton End, limestone, fl. iv.1940, *Esterhuysen* 2251 (BOL; K; PRE): flowers opening in afternoon.

This species is close to *C. asplenifolius* Burch. but is very distinct because of its pinnatipartite leaves. It appears to be confined to limestone soils and to have a very restricted range of distribution.

VERBENACEAE.

Priva auricoccea *A. Meeuse* spec. nov., *P. curtisiae* Kobuski arcte affinis sed calycibus fructiferis majoribus sparse minuteque tuberculatis, fructu aurantiaco spinis longioribus horrido praecipue differt.

Suffrutex perennis c. 50 cm. altus e basi ramosus. *Caules* erecti quadrangulati pilis rectis vel subuncinatis puberuli vel hirtelli, demum glabrescentes. *Folia* ovato-oblonga vel subhastato-oblonga, obtusa, crenato-dentata, ad basin abrupte et anguste attenuata, pilis minutis setulosis subscabra, petiolis applanatis hirtellis subnullis vel interdum ad 7 mm. longis. *Racemi* 15–25 cm. longi, subhirtelli, pedicellis infra calycem dilatatis articulatisque post anthesin 1–2 mm. longis, bracteis lanceolatis acuminatis acutissimis 3–4 mm. longis. *Corolla* ignota. *Calyx* fructifer compresso-subglobosus pilis uncinatis subvelutinus, sparse minuteque tuberculatus, 7–9 mm. longus et latus. *Mericarpia* spinis rectis vel leviter curvatis 1–2 mm. longis horrida, fusco-aurea, hirsuto-puberula, c. 6 mm. longa, 4 mm. lata, 2·5 mm. crassa.

South West Africa.—Kaokoveld: 1·6 m. N.E. of Kaoko–Otavi on road to Ohopoho, *de Winter & Leistner* 5532 (PRE, holo.!).

A perennial herb with tough base about 50 cm. tall, producing several erect and sparingly branched stems from the woody top of the rootstock. *Stems* more or less distinctly quadrangular becoming more terete when passing into the terminal spike-like racemes, rather densely leafy, shortly pubescent to hirsutulous with straight or sometimes more or less distinctly uncinate hairs, the nodes between the petioles of the opposite-decussate leaves marked with a narrow band of longer stiff hairs. *Leaves* ovate or ovate-oblong to somewhat hastate-oblong, obtuse to rounded at the apex, broadly cuneate to subtruncate at the base, abruptly narrowed at the base into narrow lateral decurrent wings of the up to 7 mm. long, setulose-hispidulous petioles, with a

distinctly but usually not very deeply incised crenate or crenate-serrate margin, apparently rather dark green above, paler beneath, on both surfaces subscabrid through fine setulose-strigose hairs with slightly raised broad base; blade 2–4·5 cm. long and 1·2–3 cm. broad, with a venation (only conspicuous on lower surface, indistinct on upper surface) consisting of a rather slender midrib from which on either side at the base of the blade a usually unequally forked rarely single secundary vein branches off and higher up 3–5 usually unforked ones branch off, connected by rather distant more or less parallel tertiary veins oriented perpendicular to the secondary ones. *Racemes* 15–25 cm. long; the axis a direct continuation of the stem and with the same type of pubescence; pedicels ultimately 1·5–2 mm. long, dilated at the apex into a flat disc-shaped articulation with the calyx; bracts lanceolate-acuminate, setulose, 3–4 mm. long. *Corolla* unknown. *Fruiting calyx* inflated, nearly closed at the orifice, orbicular in outline, laterally compressed, subvelutinous with short stiff greyish-yellow straight to uncinate setose hairs and sparsely tuberculate with blunt or pungent small protuberances, 7–9 mm. long and broad, 3–4 mm. thick. *Fruit* of 2 dry 2-celled cocci (mericarps); cocci spinescent with 1–2 mm. long straight to distinctly curved spines, of a bright golden-brown colour caused by a dense pubescence of minute stiff hairs, with the spines measuring about 6 mm. by 4 mm. by 2·5 mm.

Although flowers are lacking, the plant is clearly a species of *Priva*, a genus whose species are mostly characterised by fruit characters, the flowers being, apart from differences in size and pubescence, rather uniform in structure. In Moldenke's monograph of the genus in Fedde, Repert. 41: 1–76 (1936) it would key out as *P. curtisiae* Kobuski, an East African species, to which it is indeed closely related on account of the cocci being spiny throughout on back and sides and which it also resembles very much in habit, shape and texture of leaves, type of pubescence, " bearded " stem-nodes, etc. but from which it differs in several respects. The petioles are longer, the fruiting calyx and cocci are larger and the spines on the cocci longer and more curved than in *P. curtisiae*, the calyx bears short protuberances (not found in *P. curtisiae*) and the fruit-cocci, which are flat on the commissural surface (not excavated as in *P. curtisiae*), are of a striking golden-brown colour, hence the proposed specific epithet. It is possible that more differences will be found once the flowers of *P. auricoccea* have been collected. Although the differences mentioned may appear to be rather small, they are not smaller than those between some of the other species of long standing in this genus. In view of the urgency in connection with the preparation of the proposed Flora of South West Africa by the workers of the Botanische Staatssammlung at Munich, the description is not delayed for lack of flowers which, in this genus, are not so important for diagnostic purposes as in most other genera.